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The Ubiquitous Electron.

THE further our investigations are extended into the secrets of Nature, the more we are impressed with the astounding complexity of the structures, immensely great as in the case of the stars, or inconceivably small as in that of the atom, with which she works. Only the expert physicist can fully realise the significance of the innumerable observations and deductions which are constantly being poured forth by a vast army of experimenters in all parts of the world, but such an occasion as the recent meeting of the British Association affords the layman an opportunity at least to gaze upon the exterior of the wonderful temple of science that is being built up by these untiring workers, with electrons for bricks, and to marvel at their industry and insight. Having in mind the shortness of the period during which the electron has been known and studied, we must regard the work that has been done as but the lower courses, resting on the foundations laid by our forefathers—yet from the wonders already revealed we may form some conception of the majesty of the completed structure.

Science had never experienced such a stimulus as that which it received when the "atom" was found to be divisible into infinitesimal particles—the actual constituents of electricity. What those particles themselves consist of is one of the many problems that remain to be solved. Sir Oliver Lodge "feels in his bones" that they are ether—but even so, what is ether? There is no limit to the field for research that has been thrown open by the discovery of the electron, and that every fresh advance will further strengthen the position and enhance the prospects of electrical science is assured not only by the inherent relationship between it and the electron, and all that is associated therewith, but also by the analogy of recent history. Has not the free-flying electron already revolutionised telephony and the kindred arts? navigation by air or on the sea? the use of electricity in therapeutics? the distribution of time?

We are of opinion that it will also exercise a profound influence upon the future of electricity supply by facilitating the transmission of electricity at very high pressure in the form of direct current, and its conversion from and to alternating current at any frequency. Entirely new theories in astronomical and chemical science have been based upon the properties of the electron and its twin brother, the proton, and there can be no doubt that great advances will be made in the near future in physico-chemical science as the result of the new knowledge that is available.

In his presidential address to Section A—Mathematical and Physical Science, Professor A. Fowler, F.R.S., described the immense progress that has been made even within the past three years in spectroscopy, which, as was predicted many years ago, has proved a magic key to the secret chambers of the atom, and "seems likely in the near future to make contributions of a fundamental character to other branches of science." It now occupies a commanding position in the realm of physics, and has thrown extraordinary light upon the constitution of matter. It is not for us to discuss in detail the fascinating history of the analysis of the spectrum, which is so ably set forth by Prof. Fowler, but we cannot withhold our admiration of the work that has been accomplished. He says: "The electronic arrangements of all the elements from 1 to 92, in their normal states, may now be specified with considerable confidence." This means that in the case of such an element as lead, for instance, it is confidently asserted that surrounding the nucleus there are 82 electrons flying around with inconceivable velocity, at six different radii, and allocated definitely to 22 orbits. Not only does the spectrum tell of the loss or gain of a single electron by such an atom—it also reveals internal changes in the distribution of electrons whilst the atom remains neutral. The importance of the suggestion to which we drew attention some months ago, that the electron may be spinning, a circumstance which would solve some difficulties in connection with the fine structure of spectral lines, is indicated by Professor Fowler, who refers to the satisfaction derived from "the establishment of a beautiful order out of an apparent chaos of spectrum lines."

Whether it is desirable or otherwise to convert mercury into gold may be open to question, but the possibility of doing so has been much discussed of late in scientific circles, and was dealt with in a paper by Mr. W. W. Garrett at the B.A. meeting. The change involves nothing more than a change of unity in the atomic number (the resultant positive charge on the nucleus of the atom, corresponding to the number of electrons circulating round it), which Miethe claimed to have effected by passing a strong electric current through mercury vapour; but, so far, it has not been possile to confirm that result.

Turning to Section B—Chemistry, we meet again the electron in Prof. J. F. Thorpe's presidential address on "The Scope of Organic Chemistry." He refers to the success of electronic theories in explaining the linking of atoms, or "valency," and other problems of molecular structure, and remarks: "There can be no question that the distribution of electrons among the carbon atoms and other atoms of organic molecules must determine the reactions of the complexes involved." In Section G Professor W. Cramp described experiments on the movements of electrons and protons in an electric circuit, to determine whether the magnetic effects were identical, leading to the conclusion that in electrolytic conduction there was an actual storage of energy—the current, so to speak, left something behind in the electrolyte. Again, in our last issue we gave an abstract of the paper by Professor Vessot King in Section A, discussing the properties of the gyro-magnetic or "spinning" electron to which we have referred above, which he regards as providing "the key to radiation problems generally."

But we have said enough to show that the nimble electron, infinitesimally small though it be, plays an infinitely important part in Nature's drama, and is worthy of the rapt attention with which it is regarded by the scientific world.

Suggestion Schemes.

By many employers, suggestion schemes are regarded as at best but doubtful expedients, and probably not worth the time and money expended upon them. Such as do take the plunge, in many cases foredoom their venture from the very start—they enter into the business half-heartedly. The operatives, too, often view such schemes askance.

A recent contributor to the columns of *The American Machinist*, however, gives most interesting particulars of a suggestion scheme actually and successfully in operation. It succeeds because the workers using it find it to be a good paying proposition; and the employers clearly realise that their own success is bound up with that of their operatives.

The company is the Stromberg-Carlson Telephone Manufacturing Co., of Rochester, New York. As the business is principally of a regulation routine nature, suggestions are specially invited which have as their objective the simplification of routine. The ordinary rates of pay are already relatively high. In addition, as an incentive to really hopeful proposals, such suggestions as are approved are substantially rewarded. Their merits are assessed upon the basis of the savings it is estimated they will effect during six months' operation. All suggestions are assured of careful consideration, and the advisory and executive committee dealing with the matter meets fortnightly; thus there is very little delay in coming to a decision—a very strong pro point, as every serious student of industrial psychology must realise. For such personal recommendations as are accepted, foremen and sub-foremen receive direct payment to the estimated values of one and two months' savings respectively. These reduced rates for team leaders are designedly part and parcel of the general scheme. Quite logically their ordinary duties and responsibilities are regarded as to a large extent *including* such devising of ways and means. At the same time, however, they are given additional recompense in the form of a bonus equal to ten per cent. of the total awards made to their respective departments. This is a most wise provision. Jealousy is thus practically ruled out of the reckoning, that prolific cause of friction being dammed at the source.

The scheme has been so successful that, taken in bulk, the payments made show approximately an increase of 25 per cent. over a normal pay roll.

As an example of an English suggestion scheme, that of the London General Omnibus Company may be mentioned as having been very fruitful of results.

What one firm has done, others may do also—the same, or something just as good. Moreover, such success, it has to be remembered, brings in its train a virtuous round of benefits which in their turn minister to yet greater succes. An efficient, strong, going scheme is an asset of value, beneficial alike to manufacturer, operative, and customer. It has to be well thought out, well engineered, and above all, patiently developed. Given these requisites, not least among the benefits it confers is that of encouraging and fostering between management and works that good feeling which is at all times so great a need, so incalculable a boon when realised.

The Nature of Magnetism.

Whilst so much work has been done on the electron, it is somewhat singular that little progress appears to be made towards elucidating the nature of magnetism. That there is great scope for profitable investigation in this connection is certain; we need only cite such examples of magnetic compounds as Stalloy and Permalloy to show the immense importance of magnetic research to industry. Elsewhere in this issue we reproduce in abstract an account of the remarkable experiments carried out by Dr. T. F. Wall with intense magnetic fields; he concluded that some new phenomenon was making its presence felt, whereby the effective inductance of a solenoid was materially diminished. Exposure to an intense magnetic field appeared also to improve the magnetisation curve of a specimen of Stalloy.

Electricity in the Slate Industry.

A Complete Hydro-Electric Installation.

IT is said that the slate industry is one of the least known industries; certainly the extent of the application of electricity to the production of slate is not generally known in electrical circles. While the use of slates can be traced back to the 13th century, an active development in quarrying for the material did not commence, at any rate in Great Britain, until the latter part of the 18th century, when the extensive slate business of North Wales began to grow. The finest slate of the world is reputed to come from this part, and it is evident that enterprise has taken full advantage of this, and has been to the front all along in enlisting the scientific and engineering forces available, in their sequence of development, up to the use of modern electric machinery to-day, to assist in extracting the material from the ground and in applying the various processes necessary to develop the finished article. The necessity for employing modern methods of production is emphasised by the fact that in the market slates have to compete with tiles and asbestos. The British slate industry is also subjected to keen competition by foreign slate producers.

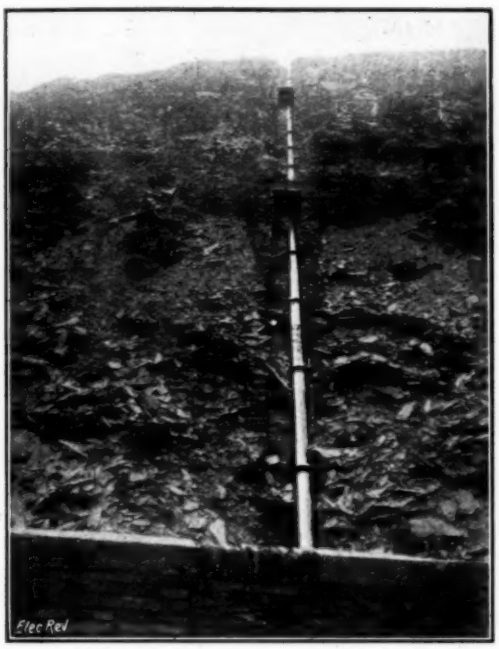


Fig. 1.—Part of Pipe Line.

One of the most progressive of the slate undertakings is that of Messrs. J. W. Greaves & Sons, Ltd., who work the Llechwedd Slate Quarries at Blaenau Festiniog, where we recently spent a very interesting day looking over the Company's workings. This concern, which is claimed to be the second largest group of slate mines in the world (the largest being Oakeley Quarry), and produces with other well-known quarries the best slate in North Wales, is still designated as slate quarries, although now most of the material is obtained by mining. The first of its slates were produced from quarries only. The interest of the undertaking is added to by the fact that it is claimed to be, with one exception, the only company of its kind in North Wales which generates completely its own electrical energy, and the first one to make use of electricity; the generating plant was first installed in the year 1891. Most of the other quarries are supplied by the North Wales Power Co., in some cases supplementing the supply by their own power.

The Llechwedd Quarries were opened by the late Mr. J. W. Greaves in 1830, and are now worked by his sons and grandsons. Their present output is about 12,000 tons of slate per year, but the figure has been as high as 26,000. During the war the output dropped to 3,000 tons per annum, and a steady increase has since been amintained. About 500 hands are at present employed. The quarries, situated on one end of the Snowdon range, between 700 and 1,700 ft. above sea level, are favoured, or otherwise, with a very heavy rainfall, averaging about 120 in. per annum, which results in a very convenient supply of water for hydro-electric purposes and in the utilisation of a considerable portion of the energy generated for pumping the flood water from the mines. Water is collected in an artificial lake, about 1,300 ft. above sea level, which is fed by four main reservoirs, situated some 300 ft. above the lake, through

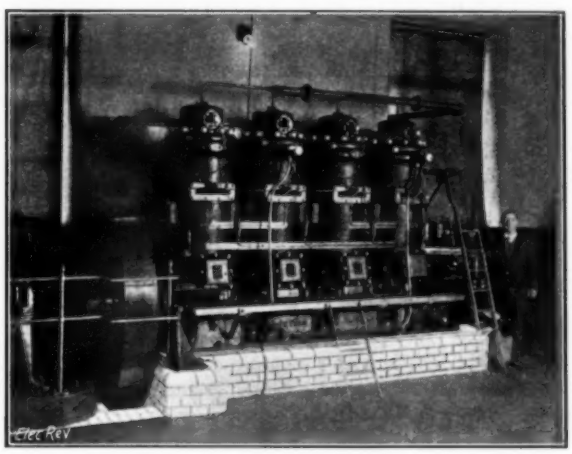


Fig. 2.—Oil Engine.

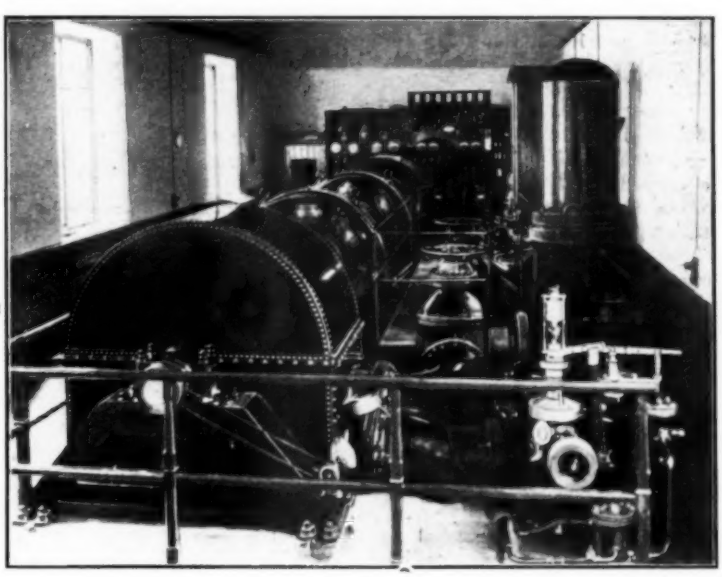


Fig. 3.—Power Station, showing Turbine Plant.

natural waterways. The power station is positioned about 540 ft. below the lake, and the turbines are fed through an 18-in. pipe line, fig. 1. This is the only feed to the station at present, but provision is made for a second line which will carry direct from the main reservoirs, an 800-ft. head. The existing pipe line is three-quarters of a mile long. The generating station, which is situated at about 750 ft. above sea level, is equipped with two 250-kW turbines, fig. 3, which provide for the normal requirements of the workings, and a 160-kW

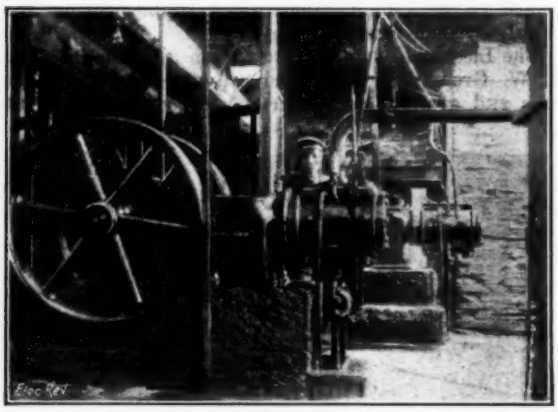


Fig. 4.—Compressor Plant.

oil-engine set, fig. 2, which has been found necessary to meet the demand at times of peak load. With regard to the installation of the oil-fuel plant, the position is somewhat curious. Although a 10,000-V transmission line of the North Wales Power Co. passes directly over the quarries, Messrs. Greaves did not find an offer of the Power Company to supply electricity to them sufficiently attractive to deter them from installing the oil engine.

The turbines are of the Pelton-wheel type, and were supplied by Messrs. Gilbert Gilkes & Co., Ltd.; they are fed direct through branch pipes, fitted with ordinary stop valves, at the foot of the pipe line. An interesting feature of the line is the provision, at the foot, of two air buffers, fig. 3 (right), one on each branch pipe. These are intended to relieve the line of the "velocity pressure" of the water in the event of the main turbine valve closing suddenly. A relief valve on each buffer is arranged to admit the water, on a given line pressure developing, against the pressure of the internal air. In addition to this safeguard, ordinary spring-loaded safety valves are provided on the line. Each turbine passes 350 cu. ft. of water per min. at full load, and the discharge is again utilised by the Yale Electric Power Co., whose generating station is conveniently situated lower down the hills, for generating a public supply of electricity for the town of Blaenau Festiniog. Arrangements are made between the public supply company and Messrs. Greaves for an exchange of energy in case of emergency.

The governor gear of each turbine is of a somewhat unusual design, which has proved particularly helpful in connection with the parallel running of the water and the oil plant. An ordinary centrifugal-type governor operates a piston in a hydraulic cylinder placed vertically under the governor. A second hydraulic cylinder, similarly equipped with a piston, is placed horizontally as a projection of the stop valve on the pipe line, the valve being directly connected to the piston. Pipe connections between the corresponding ends of the two cylinders allow the transmission of fluid as the first piston is moved by the governors, and in consequence a corresponding movement of the valve. The rate of operation of the valve is controlled by an oil "dash-pot" cylinder, in which a piston carried by an extension of the valve spindle moves in oil. A pipe connects the two ends of the oil cylinder, and the oil flow is regulated by a small valve. To compensate for

Fig. 5.—Slate Haulage System.

any sudden drop of load off the turbines, an artificial load is temporarily placed on the mains. At a given speed the governor spindle closes a switch controlling a small motor; this operates a liquid resistance which is connected to the supply mains. This device is of the Company's own design. The two turbines run practically all the time in parallel, and at peak load no trouble is experienced with the parallel running of the water- and oil-driven machines. Each turbine is directly coupled to a 250-kW, 550-V, shunt-wound dynamo of Messrs. Johnson & Phillips's manufacture.

Fig. 6.—Underground Pumping Station.

The oil engine is of the Vickers-Petter CR4, 4-cylinder, 2-stroke type. It was chosen particularly on account of the absence of valves, the inlet and exhaust being effected by means of cylinder ports, an important factor, as the Company has to undertake entirely its own repairs. The fuel is injected solid under a pressure of 1,000 lb. per sq. in., and at starting

ignition is provided for by means of a heating element in each cylinder. These elements are loaded at 30 A, 6 V, and are supplied by a battery equipped with the necessary change-over switch for charging purposes. The starting equipment was installed by the owners. An automatic oil-feed system from external tanks is provided. The engine is directly coupled to a generator supplied by the Electric Construction Co., Ltd. The full-load fuel consumption of the engine on test was 0.466 pint per b.h.p.-hr., and the cost per kWh for fuel and lubrication was 0.4d. The corresponding cost, after allowing for interest and depreciation and maintenance, is calculated at 0.7d., while the overall cost per kWh on the hydraulic portion of the station is 0.45d. It is interesting to note that the inclusive figure of 0.7d. per kWh is less than the figure given by the makers (0.728d.). The energy generated is distributed from an open-type slate-panel switchboard (fig. 3), and is transmitted to various distribution points throughout the workings by bare overhead lines carried on wooden poles by pin-type insulators bolted through cross arms. The total length of overhead line in use is about 2,500 yd. Armoured cables are installed underground either in wooden cases fixed to the walls or carried on porcelain cleats similarly fixed.

Fig. 7.—Underground Haulage Equipment.

As already stated, most of the slate is produced from underground workings. Three mines are operated, Llechwedd, Sink Fawr and Ffridd; time permitted us to see only the first-named, but some impressions of this will suffice to give a general idea of the mining in the district. The slate runs in veins at an angle of about 40 deg. from the horizontal. An incline is dug out somewhere near the end of the vein, and the slate is attacked at different levels, or floors, down the incline. Five floors are contained in the Sink Fawr mine. Cathedral-like chambers or caverns are excavated at the levels, the roofs of the caverns being first prepared and then the contents removed. The chambers vary from 30 to 45 ft. in width, depending on the nature of the roof, and about 50 to 70 ft. in depth. In the main veins, something like 30 chambers are constructed on each floor. The rock is removed from the caverns in blocks varying from 1½ to 2½ tons in weight, the object being to produce them of a size suitable for economic working in the preparation mills above ground. Across the slants of the rock, parallel to the bedding, "joints" run in the rock and are taken advantage of in removing the slate. Holes are drilled in the slate in line with the cleavage of the material at right angles to the joints, which provide a "natural" break or split in the rock. The drills are driven by compressed air supplied from a system of pipes, which is connected to four compressors, two underground and two above, which give a total supply of 950 cu. ft. of air per min. at 100 lb. per sq. in. In some cases, where vertical drilling is possible, Marvin-Sandycroft electrical drilling plant is used. The compressors are all electrically driven; the driving motors of the underground machines are of the compound-wound type of 40 and 50 h.p., and those above ground are shunt-wound machines, each of 25 h.p. Fig. 4 shows the compressors above ground.

As already indicated, one of the greatest difficulties in the mines is to keep the water "under," and to this end a large proportion of the power generated is used, totalling about 220 h.p. In Sink Fawr eight motor-driven pumps are installed, varying from 5 to 33 h.p. each, and totalling 170 h.p. These are stationed on various floors in pump rooms dug out of the rock. The water drains down the inclines and communicating passages, and is collected in sumps at convenient positions. In some cases the water is pumped from the bottom floors to the top in two stages. Fig. 6 shows one of the underground pumping stations. It is interesting to note that the water from the mines is so pure that it is claimed to be a "perfect" insulator. Another general feature of the underground workings is the refreshing atmosphere, due largely to natural ventilation and the height of the workings above sea level: a practically constant temperature of about 45 deg. F.

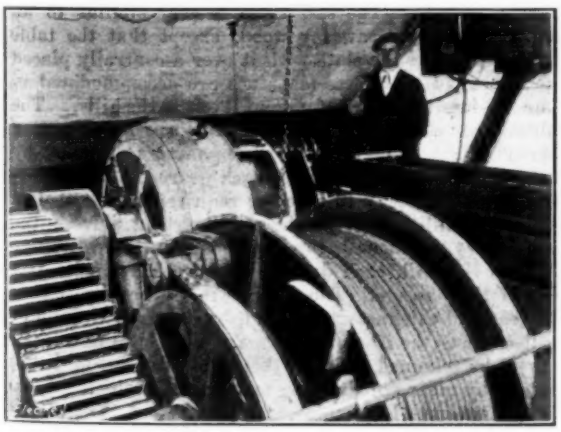


Fig. 8.—Main Winding Gear.

Fig. 9.—Battery Truck Underground.

is maintained in the mines throughout the year. The various pump and compressor stations, and places wherever machinery of any description is installed, and the dining chambers for the workmen, are electrically illuminated, the lighting wires being run about the workings in the same manner as the power mains, either in wooden cases or on porcelain insulators.

The blocks of slate and a large quantity of rubbish which it is necessary to remove are brought to the surface principally by electrically-controlled winding plant. For Llechwedd and Sink Fawr, three haulage systems are installed. One, above ground, serves the three top floors, and the lower floors are served by two smaller gears underground. Each of the under-

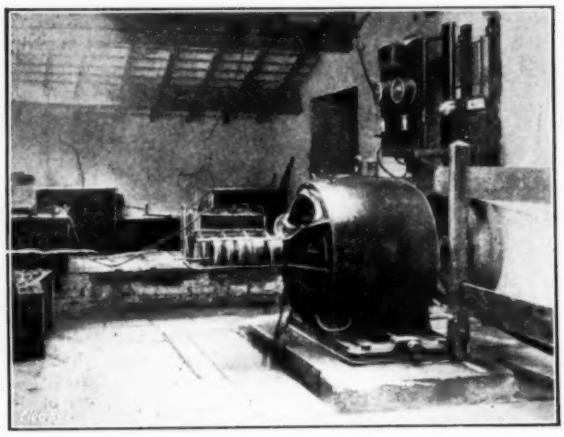


Fig. 10.—Battery Charging Station.

ground equipments, fig. 7, consists of a small winch driven by a 12-h.p. motor. In the other mine, two larger equipments are employed, and are driven in each case by a 58-h.p. compound-wound motor.

The inclines are metalled with a light-gauge track over which low trucks are hauled; the slate blocks are lashed to these trucks, fig. 5. The main haulage equipment for Llechwedd and Sink Fawr is driven by a 150-h.p. G.E.C. motor running at 360 r.p.m., and providing a winding speed of 4 ft. per sec. The electrical equipment was installed to replace a horizontal steam engine, which is still in position. The motor is coupled to the old crank shaft, the connecting rods being disconnected at the big-end bearings. The old flywheel of the steam plant has

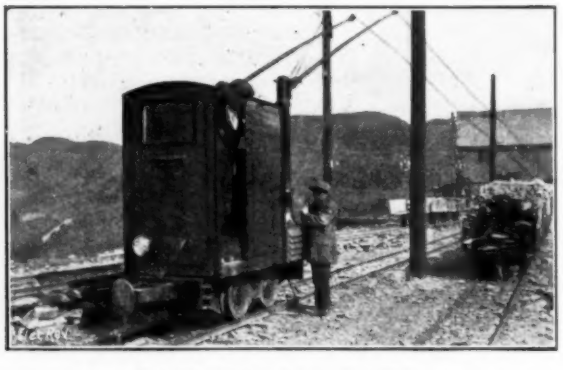


Fig. 12.—Trolley Locomotive, 10 h.p.

been left on, and this enables the motor to be stopped before the wagons reach the top of the incline. The motor is controlled by a liquid-resistance controller of the firm's own design. A series of cast-iron containers for the acid solution stand in water in a wooden trough, and accommodate zinc-plate dippers. The main incline is 1,000 ft. long.

The main winding equipment for the principal rubbish tip, fig. 8, is of unusual interest. It is a Scott and Mountain winding gear, driven by a 100-h.p. motor. A pulley on the end of the automatic brake drives a 20-kW Electric Construction Co. generating set, 220-V, for supplying energy to an overhead trolley system. A 10-h.p. electric locomotive, fig. 12, is used in connection with this for conveying slate and rubbish from the open quarries to the mills and tip grounds. This loco. weighs $3\frac{3}{4}$ tons. Battery trucks, fig. 9, are also used in this connection, and where the inclines are not more than 1 in 100, they are used underground. Both the overhead-trolley and battery locos. were supplied by British Electric Vehicles, Ltd. It is interesting to learn that the saving resulting from the use of each battery truck over the cost of the original equivalent horse labour amounts to £400 per annum, and that the working of the overhead loco. has resulted in £125 per year being saved on the running costs of a steam locomotive which it replaced. The trolley vehicle is equipped with tramcar-

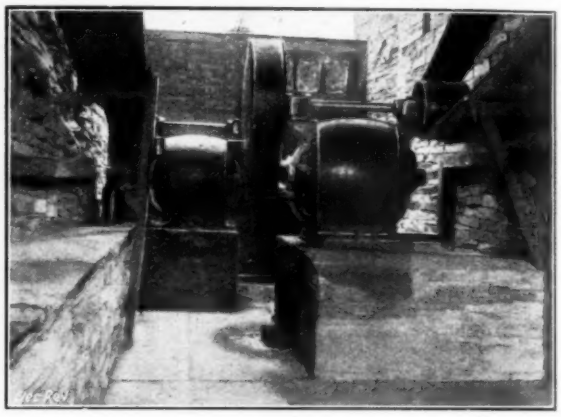


Fig. 11.—Saw-Mill Drives.

type controllers, giving two running speeds in each direction. Each battery truck is of 3 h.p. A battery-charging station, fig. 10, receives the trucks when the batteries require charging, the metals being run direct into this building.

For every ton of slate which is removed from the ground, thirteen tons of rubbish are brought to the surface; the cost of removal is 4s. 6d. per ton. About 14,000 tons of rubbish is removed per month, most of which is disposed of over the side of the mountain at the main tipping ground, 1,300 ft. above sea level.

On removal from the mines, the slate blocks are transported to the mills, where they are converted into the finished products. The blocks are first split into thinner blocks about 3 in. thick, which are dealt with on sawing tables, where they are sawn down to the approximate sizes required. The saw table is very similar to an ordinary circular saw for wood, except that the table moves, carrying the slate with it over a centrally placed saw. About 100 of these machines are accommodated in four mills situated at different levels in the hills. The tables are electrically driven, and a 15-h.p. motor serves every 15 tables. The motors, made by Messrs. Sandycroft, Ltd., are back geared, a big reduction being necessary to give the required table speed of 40 ft. per min. Fig. 11 shows interesting drives; the two motors are housed in a passage built sectionally through the mill, each driving the machines on its own side of the passage. The cut blocks are next split into the required thicknesses by hand, by means of chisel and mallet, along the line of cleavage. The slates have only now to be trimmed down to the required sizes, and this is done by means of dressing machines, in which revolving knives cut the surplus material away. These machines are also electrically driven. The slates are next stacked in the open according to their sizes and quality. In addition to slates for roofing, switchboard slabs and billiard table tops are produced. Harder rock with poor cleavage is used for these, and the rough blocks are dealt with on electrically-driven planing machines housed in separate departments of the mills.

A feature of the whole undertaking is that from the point of view of maintenance, it is practically self-contained; the only repair work which cannot be undertaken is that where casting is required. Up-to-date workshops, carpenters', blacksmiths', fitters', and arma-

ture repairers', equipped with electric drives, are maintained for the considerable amount of repair work necessary. The majority of the company's output is shipped abroad from Portmadoc, whither the slates are conveyed by gravity trucks on a light railway down the incline from the hills to the coast. The products for use in England are mostly transported by means of light-gauge lines to the main railways.

In addition to slate, granite and zinc are produced in the district. Blaenau Festiniog is practically wholly dependent on the slate industry, and it is interesting to note that when the quarries of Messrs. Greaves were first established, the town consisted of only ten houses.

In conclusion, we wish to express our thanks to Messrs. J. W. Greaves & Sons, Ltd., for their courtesy in allowing us to view the workings, and to Capt. M. I. Williams Ellis, engineer and manager, for his assistance in the collection of the above information.

Those New Models!

Changes in Radio Receiving-Set Design and Price Cutting.

By A. J. SMITH.

AT first sight, the regular release of new models might be considered a healthy indication of steadily increasing technical improvements in an industry. Close acquaintance with the radio trade in one or two countries, however, is apt to modify this opinion considerably, and the trade of this country has before it the example of the United States, where the appearance of a new model is simply an excuse for the wholesale dumping by the manufacturer of his unsold stock upon the nearest departmental stores, at figures bearing no relation to the cost of production or the previous trade prices, on the mere plea that this stock is " obsolete."

There are clearly certain occasions when the issue of new models becomes absolutely necessary, and no fair-minded trader would be disposed to question the policy when such occasion arises. We may take as a typical instance of such a need the early days of broadcasting, when the use of reaction on the aerial circuit was prohibited by the postal authorities. All the simple receiving sets built to comply with this ruling were legitimate new models. A few months later, the instruments which were developed to employ reaction on a closed circuit and approved by the Postmaster-General under the old regulations marked another legitimate new model in receiving sets, and though traders might view with some concern certain unsold examples of old sets which they still had on their shelves, no one could deny that the progress in receivers in those early days made the development of new models strictly necessary, or that there was praise rather than blame attributable to the maker who endeavoured to keep himself just a little in front of the market. Luckily changes in official regulations have now ceased to occur, but the policy of introducing new models continues throughout the trade, and traders have begun to ask what is the justification for some of the practices which accompany it.

To adhere to the example of wireless receivers already quoted, we may take the further case of the maker who decides to try the effect of a drastic reduction in price for the next season. He may be quite free from selling policies or agency arrangements which stipulate for a refund to the trade in the case of a price reduction, but to be on the safe side he decides that in launching the price reduction it would be as well to alter the design of the cabinet slightly, and possibly to vary the position of the valves somewhat. The circuit may remain unaltered, and the results obtainable may be identical, but the slight modifications constitute a new model. The policy is legitimate provided it is not employed as a means for evading any outstanding commitments in the way of refunds or credits, but if it is, or if the production of a " new model " is to be made the pretext for unloading large quantities of existing stock in questionable quarters at sacrifice prices, it is undoubtedly at this point that the trade should call a halt. On the face of it a fresh design of cabinet, a slight alteration in the shape of a loud-speaker flare, or the change of knob on a coil-holder hardly seem sufficient justification for employing such a radical designation as " new model "; but if a manufacturer is a whole-hearted believer in the policy of periodical new designs, whether the improvements in his product merit the term or not, there can be on the part of reasonable traders no objection to the plan provided (and it is a big proviso!) that it is not followed by a policy of wholesale price-cutting on the part of the maker in unloading his so-called " obsolete " stock. The only criterion as to the extent of a price reduction which may sometimes be warranted in order to clear a few obsolete or non-current articles is to be found in the comparative results. The make and the workmanship will be the same in the case of both old and new patterns, and it only requires a practical test to furnish an answer to the question: " Is the old model such an indifferent or poor production compared with the new one as to justify its immediate realisation at a price which is one-quarter or one-fifth of the price paid for it by legitimate traders up to the date of the release of the new design? " If results are equal, obviously such dumping cannot be justified, either upon commercial or other grounds.

From the point of view of the general buying public, it is easy to exaggerate the selling value of novelty unless the change in design is very striking indeed. The purchaser of a well-advertised telephone does not care in the slightest whether the pattern is designated as the obsolete " X241 " or the new " X243," especially when there is not the slightest difference in results; nor does the buyer of a loud speaker mind whether his instrument is mounted upon feet or upon a solid base. In neither case will the user be disposed in the slightest degree to scrap an excellent instrument merely on such a pretext, nor would such a change affect the prospect of a sale one way or the other; but the confidence of a buyer is badly shaken when he notices that a little delay in buying, and a little investigation in some of the " bargain quarters " of the radio trade, would have enabled him to effect a saving of some 75 per cent. on the price which he paid to the legitimate trader. The disposition to search in all likely and unlikely quarters for cut-price bargains is a frame of mind which it is easier to instil than to eradicate from the mind of the buying public, and if such practices as those indicated tend to divert support from legitimate trade channels to the job-line merchant, it is a change which will in the long run be harmful to the manufacturers, the trade, and the public. We have, fortunately, the example of the American radio industry to show to what excesses such a policy will lead if it is not checked upon its first appearance, and if in this country we have not up to the present had many glaring instances of any abuse of this policy, there has, nevertheless, been sufficient indication of its evils to ensure that the vigilance of the trade and the trade Press in watching its development will not be misplaced.

Electric Steam Generation.

Details of Modern Electric Boiler Equipment.

By C. H. TUPHOLME.

IT is sometimes profitable to generate steam electrically, particularly where electrical energy can be purchased cheaply, or produced, equally cheaply, from water power, in a large industrial organisation. In the latter case, the excess of electrical energy available at certain seasons may be used to generate process steam for use in the works, and in those instances where an industrial concern purchases power up to a certain maximum capacity at a fixed annual charge, steam may be obtained economically from the electricity generated in excess of the demand, up to the maximum quantity contracted for. This arises from the fact that it is practically impossible to work up to the demand contracted for throughout the year, and unless some means are devised for making up the deficiency many units of electrical energy are paid for, but not used. It is evident, therefore, that in an industry which needs steam for any process, it will be of advantage to raise this steam by the use of the surplus electrical energy instead of using coal, oil or other fuel for the purpose.

It is claimed also that it will pay to install an electric boiler in industrial plants where a comparatively small amount of process steam is necessary at a considerable distance from the boiler house, the electrical energy required being transmitted to the boiler from the main generating plant.

Another application, which is in use in both Canada and the United States, is for the central power stations that have excess energy to install and maintain electric steam boilers in industrial plants and sell the energy on the basis of metered steam.

Control may be varied to meet individual requirements, as by the use of suitable auxiliary apparatus it is possible to maintain either constant steam pressure; constant temperature; constant power input; or variable power input, so that the steam generator will absorb all excess power.

Electric warm-water and steam boilers for use on high-tension electric supply have come into greater use on the Continent since the war. For such large powers as these boilers require, and for the direct application of high-pressure current, the use of any of the methods of electric heating by resistances, such as are employed in small boilers and heaters for low-voltage work, is quite out of the question. Also the principle of heating by induction, where masses of metal are heated by means of eddy currents, could not be used on account of the great expense involved in constructing such apparatus.

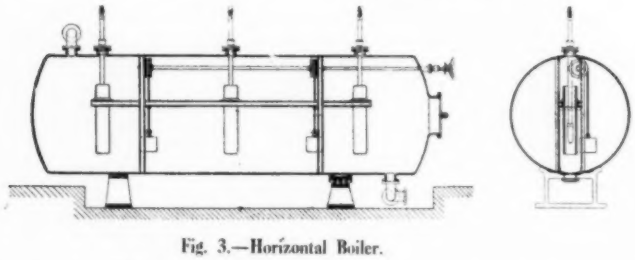


Fig. 3.—Horizontal Boiler.

The method adopted has been to fit the boilers with electrodes immersed in the water, the water itself becoming the resistance for the electric current. Heating in this manner by electrodes is really not new; it has long been applied in one way or another, for instance, as a simple method of absorbing the electrical energy when testing a generator. Of course, only alternating current can be employed, as direct current would decompose the water into oxygen and hydrogen. These boilers have already been used on 8,000-volt circuits, and experiments are at present being carried out which, it is hoped, will result in their being made directly available for any pressure up to 15,000 volts.

Figs. 1 and 2 give examples of large boilers, fig. 2 being a standard type used on the Continent, designed and constructed by Sulzer Bros. on the basis of experiments made in the autumn of 1918. It may be mentioned, as an example, that one of these boilers has been continuously at work, day and night, in one works since September, 1919. As long as water-power is available to generate electricity, this boiler works every week from Monday morning till Saturday night, consuming from 1,000 to 2,000 kW. It uses a total of about 150,000 kWh per week, thereby saving 1,000 to 1,500 tons of coal per annum.

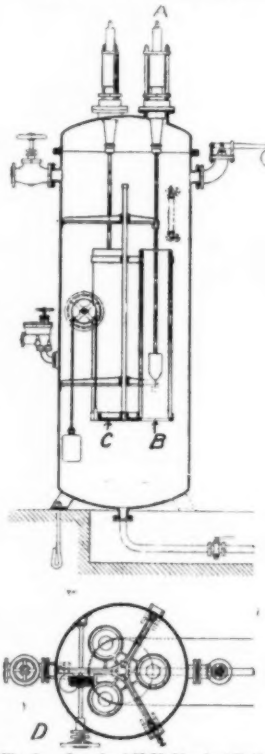


Fig. 1.—Standard H.V. Vertical Boiler.

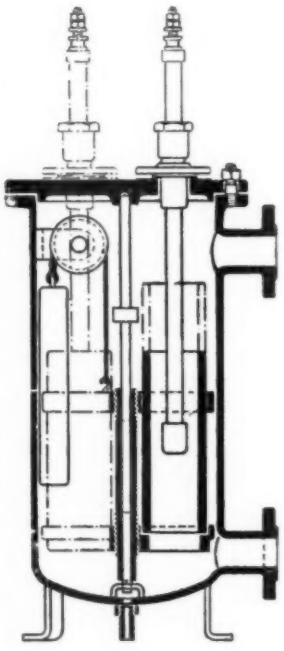
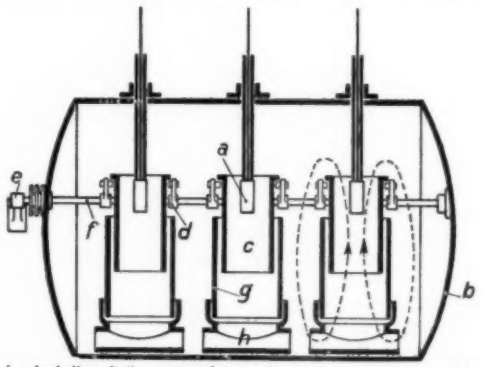


Fig. 2.—Continental H.V. Boiler.

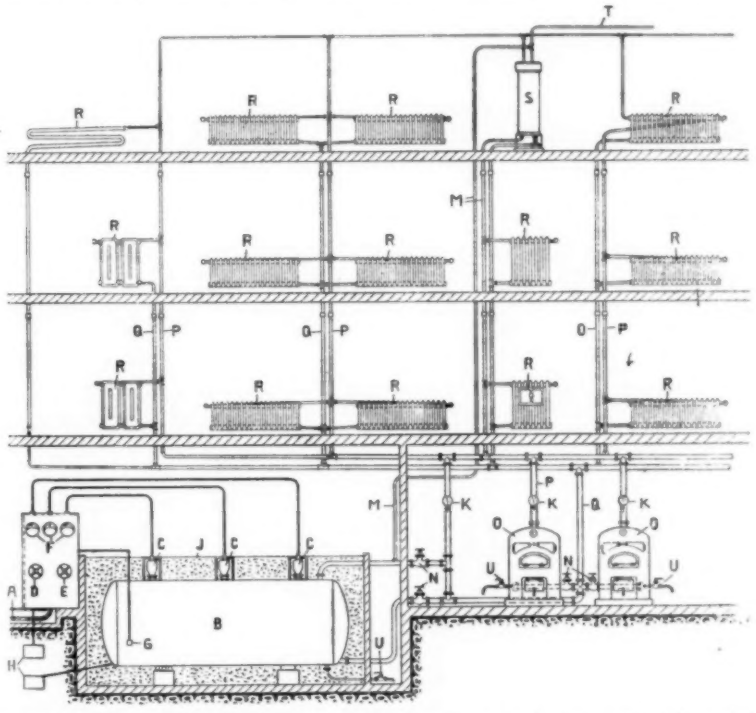


a, electrode; b, boiler shell; c, vaporising tube; d, e, f, regulating device; g, h, extension tubes.

Fig. 4.—Boiler with Regulator and Vaporising Tubes.

The method of working these electric boilers can be seen clearly from fig. 1. Current is led from the terminal A to the electrode B, which is surrounded by the so-called vaporising tubes C. D is a device for regulating the amount of resistance.

The vaporising tubes were adopted because they increase the circulation along the electrodes. The brisk circulation thus attained prevents steam bubbles accumulating on the electrodes and disturbing the total resistance of the circuit. The output of the boiler is also increased for the same reason. Another advantage of these tubes is that the current flows from the electrodes through the upper and lower openings to the neutral point, *i.e.*, to the metal support on the end of the vaporising tubes. By raising and lowering the tubes the path through the water from the electrodes to the neutral can be shortened or lengthened. The conductance is therefore increased or diminished, and the heating effect of the current can in this manner be regulated within wide limits. Directing the current in the required path avoids the risk of its passing direct from one electrode to another, especially if the water in the boiler is a fairly good conductor. The adjusting of the tubes may be done by hand or automatically. In this way it is possible to keep the current, and therefore the heating effect, constant, even when the temperature of the water is always changing. This would not be possible without a regulating device, as the conductivity of the water increases as its temperature rises. Consequently the heating effect also rises, until it suddenly falls again when steam begins to form. Electric boilers have already been made capable of storing heat energy equivalent to 6,000 kWh.



A, electric mains; B, electric storage boiler; C, heating elements; D, hand wheel to oil switch; E, hand wheel for current regulation; F, ammeters; G, temperature contact; H, earthing; J, heat insulation; K, thermometer; M, safety pipe; N, valves; O, coal-fired boiler; P, hot water delivery pipe; Q, hot water return pipe; R, radiators; S, expansion tank; T, safety overflow; U, drain cocks.

Fig. 5.—Electric Boiler with Heat Storage in Central-Heating Installation.

Figs. 3 and 4 give illustrations of large horizontal electric boilers, such as have for some time been at work and given complete satisfaction. In fig. 4 it can be seen how extension tubes are fitted to the vaporising tubes in order that the water circulation may be effective in the lower part of the boiler also. These tubes are made of metal and form the neutral point. It is possible to regulate the heating effect in the boiler in other ways than by moving the vaporising tubes, and numerous patents have been taken out in this connection.

As electric heating is particularly suitable for using electric current which could not be otherwise employed, and also for using current during the night when it is cheap, the correct method of applying the available current and of conveniently storing the heat energy is all-important.

Countries with large hydro-electric stations generally have a superabundance of water at their disposition in the rivers in summer, and consequently large quantities of electrical energy to dispose of, if a customer can be found for it. In winter, on the other hand, the rivers are low, and the available supply of electric energy is often short of requirements. In order then to save coal, it is often advantageous to use the electric current in summer for water heating and steam raising, and only to use coal in the winter. It may thus prove worth the expense of installing boilers for coal firing as well as those electrically heated.

With regard to the heating of buildings and dwelling houses, the conditions in spring and autumn are quite similar. Here, also, it is often found to be advantageous and very convenient to heat, now and again, by electricity. As is well known, small apparatus have long been used for this purpose, but only for warming single rooms. Now an electric boiler can be installed alongside the coal-fired boilers and used for warming the whole house. Such an installation, combining the two methods of heating, is shown in the accompanying illustration (fig. 6).

The conditions are quite different when electricity is required for heating all through the winter, whether for warming water or for raising steam. Then the most important consideration is the efficient storage of heat energy, as it is generally necessary to employ as far as possible the cheap surplus electricity available, and this in winter can only be had during the night and at odd moments during the day. Sulzer Brothers effect the storage of heat in water accumulators, where the water is warmed, according to the pressure it is under, to from 212 deg. to 265 deg. Fahr. (100 deg. to 130 deg. C.) for heating purposes, and to 375 deg. Fahr. (190 deg. C.) for steam raising.

The manner in which the stored heat is drawn off when required naturally varies very much. When a building has to be heated, the highly heated stored water is drawn off from the accumulator in the quantity required, and added to the water circulating in the heating system. Fig. 5 gives a scheme for such an installation. The electric boiler B is arranged as a well-insulated heat accumulator, and is located near the coal-fired boilers O. Hot water from the accumulator is added to the water in the main system through the pipe P, the quantity being regulated by the valve X according to requirements.

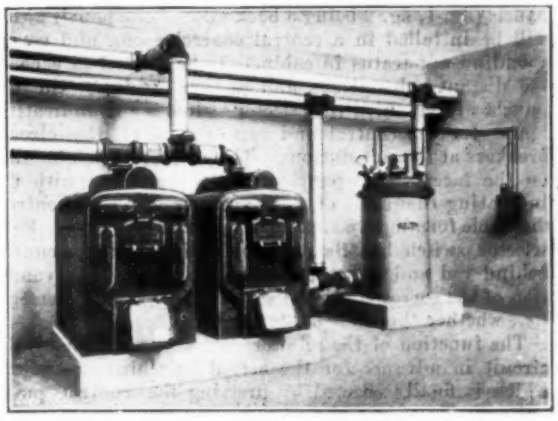


Fig. 6.—Coal and Electric Combination.

(To be concluded.)

Automatic Railway Sub-Stations.

Supervisory Control Gear Made by the Automatic Telephone Manufacturing Co., Ltd.

Modern practice in the operation and control of hydro-electric generating stations and of static and converter sub-stations situated at varying distances from the central main generating station calls for means whereby the various switching operations at the remote stations can be directly controlled from the main station or other control point; furthermore, the due accomplishment of these various operations has to be accurately recorded back at the control centre.

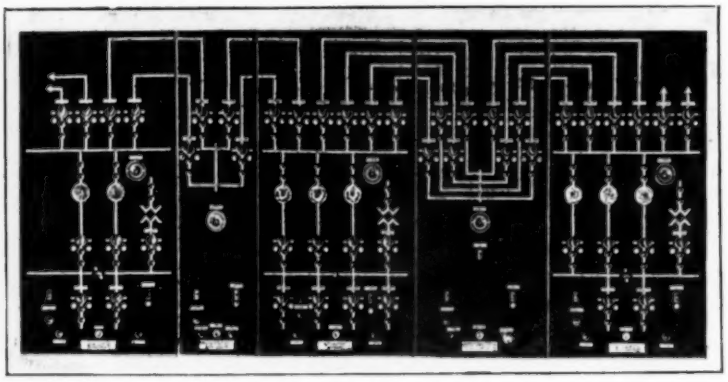


Fig. 1.—A 5-Panel Control Board.

Following the success of the remote-control and supervisory apparatus designed and manufactured by the Automatic Telephone Manufacturing Co., Ltd., to the order of the Metropolitan-Vickers Electrical Co., Ltd., for the City of Wellington tramway system in New Zealand,* the Metropolitan-Vickers Co. put forward A.T.M. equipment for the supervisory controlled sets of rotary-converter equipment which it is supplying to the order and specification of the Bombay, Baroda, and Central India Railway Co. in connection with the electrification of suburban lines of that company round Bombay.

The specification was fairly elaborate and called for (*a*) a control board showing diagrammatically all the main electrical connections of the apparatus controlled by supervisory apparatus, and (*b*) the installation of temperature alarms to indicate on the supervisory control board when a machine is approaching an unsafe operating temperature. The plant to be controlled comprises 20,000 kW of rotary converter plant in three automatic sub-stations, 22,000-h.p. feeders, 1,500-V d.c. traction feeders, railway station lighting transformers, and circuit breakers in two track-sectioning cabins.

The supervisory equipment comprises five control panels (fig. 1, fig. 2 being a back view of one panel) which will be installed in a central control room, and corresponding apparatus in cabinets to be located at each of the distant sub-stations and section cabins. On the panels are mounted the selector switches and indicating lamps for the control and supervision of the circuit breakers at the sub-stations. The selector-switch handles on the face of the panels are all associated with the indicating diagrams of the power circuits they control, the whole forming a complete diagram of the system. Each selector switch has its own indicating lamps mounted behind red and green opal glass, to indicate the condition of the corresponding distant circuit at any moment, *i.e.*, whether "open" or "closed."

The function of the selector switches is to prepare the circuit in advance for the actual switching operation, which is finally effected by pressing the control push-button. To ensure the correct condition of the circuit following the manipulation of the selector switch, subsidiary pilot lamps are provided, and the operator awaits confirmation of the circuit by these lamp signals before finally pressing the control button. This is an important feature, inasmuch as it ensures absolute certainty of correct selection and relieves the operator of anxiety regarding possible errors in switching.

Other indicating lamps on the panels furnish immediate warning of undue temperature rise in the windings of the running plant at the sub-stations, while facilities are provided which enable the operator to check the condition of the distant switches at any time by operating a special checking key. In addition, audible alarms call attention to any change in the conditions at the distant sub-stations. Two main pilot lamps on each panel indicate to the operator, whilst switching, that the signalling impulses are actually being transmitted over the line wires and, in due course, back to the central control room. There is also provision on each panel for carrying out daily routine tests on the line equipment.

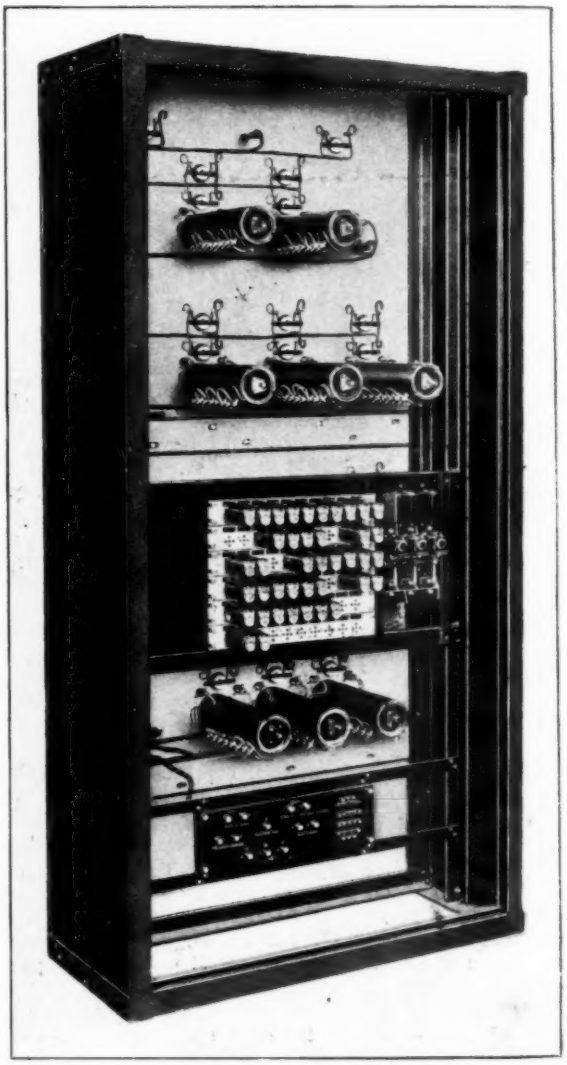


Fig. 2.—Back View of one of the Panels.

The panels constitute the fronts of independent cubicles containing the apparatus, with removable doors

*Elec. Rev., October 16th, 1925.

at their backs, and they are dustproof and metal-cased. Each is connected with its corresponding sub-station apparatus by a pair of pilot wires, whilst a common return from all sub-stations leads back to the central control board; over the pilot wires the whole of the actual switching operations are effected and their due accomplishment is recorded back to the attendant in charge, so that, irrespective of the number of circuit breakers to be controlled and supervised at any sub-station, only one pair of pilot wires and a common return are necessary between the central and each distant point.

The A.T.M. system is based on step-by-step mechanism which is analogous to that constituting the (Strowger) automatic telephone system, and its current consumption is so small that, should circumstances require, primary batteries may be successfully employed to operate it.

The Production of High-Voltage Direct Current for Cable Testing.*

A Review of the Available Methods of Generation.

By N. A. ALLEN, M.Sc., Eng.

THERE are several methods which may be employed for the generation of direct current at a high voltage, and a brief account of each is given below, together with notes on their adaptability for cable testing in the field.

Low-Voltage Machines in Series.

The method adopted for obtaining a high-voltage direct-current supply with a large power output, as used in such schemes as the Thury constant-current series system, is to couple up a number of low-voltage dynamos in series so as to give the required pressure, the whole plant being insulated for the full working pressure. Owing to the form of the lay-out and the prohibitive cost of the apparatus for small power outputs, this method cannot be followed for cable testing in the field.

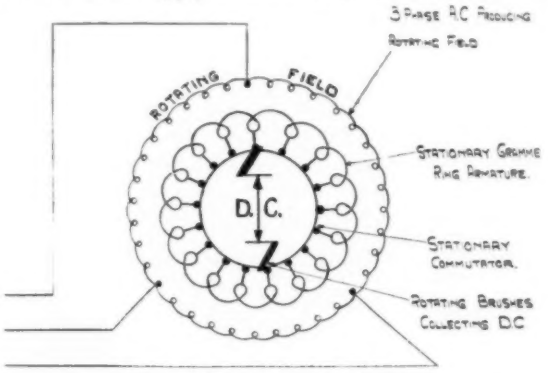


Fig. 1.—Representation of Transverter.

The Transverter.

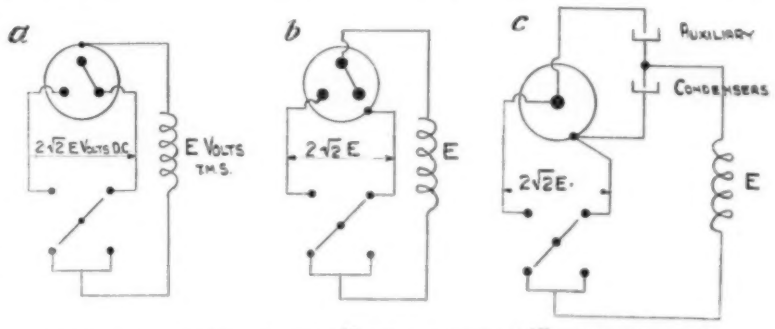
A simplified diagram of connections of the transverter is given in fig. 1. One can imagine an inverted generator where the armature and commutator are stationary, while the magnetic field and brushes rotate, so inducing an alternating e.m.f. in the stationary armature. Thus, in the transverter a three-phase supply induces a rotating field, as in the stator of an induction motor. By abolishing the air gap between the armature and the field system, thereby increasing the efficiency, a transformer having the usual primary and secondary windings is obtained. By suitably interconnecting the windings, the e.m.f.'s in the secondary can be made to assume their correct phase, and thus a 36-phase secondary voltage is impressed on the commutator. By driving the brushes in synchronism with the a.c. supply, a d.c. voltage can be collected from the commutator, and since the problem of insulation is much simpler with stationary windings, each commutator can be arranged to give 10,000 volts without exceeding the voltage per segment which is usual for d.c. machines. By connecting commutators in series, very high direct-current pressures are attainable.

In its present form the transverter is commercially possible only for large amounts of power, and owing to its bulk it would not be practicable for use in a portable cable-testing set.

The Delon Mechanical Rectifier.

The principle of the Delon mechanical rectifier is so well known as to require no further description. Fig. 2 shows in a simple form the diagram of connections for the apparatus as applied to the testing of cables, the three cases considered being the core-to-core test, the core-to-sheath test, and a single-core cable test.

Although the Delon rectifier has been widely used for testing high-voltage cables in Great Britain and on the Continent, experience has shown that much trouble is encountered owing to the fact that the operation of the apparatus depends upon a spark-discharge across from the rotating contacts to the stationary collecting brushes, whereby, in a greater or less degree, depending on local conditions, surges and oscillatory discharges are liable to be set up. Such oscillations may permanently weaken the dielectric and possibly cause a failure in the cable, and it is this undesirable feature which led to the development of the apparatus described later, this set being one of the first of a similar type which is beginning to be widely adopted for testing high-voltage underground lines after installation.



(a) Core-to-core test of 3-core cable; $2\sqrt{2}$ E volts core to core; ($\sqrt{2}$ E volts core to ground).
(b) Core-to-sheath test of 3-core cable; $2\sqrt{2}$ E volts core to sheath; ($\sqrt{2}$ E volts core to core).
(c) Core-to-sheath test of single-core cable; $\sqrt{2}$ E volts core to sheath.

Fig. 2.—Delon Rectifier Applications.

The Kenotron Rectifier.

The natural outcome of the development and extensive use of high-power X-ray tubes with direct current

* This is the second of a series of four articles dealing with the tests which are applied to high-voltage cables after installation, adopting direct current as the testing medium. The first article appeared in the ELECTRICAL REVIEW of August 6th, 1926.

of the order of 10,000 volts upwards has been the application of these sources of power to the testing of cables.

The Kenotron tube illustrated in fig. 3 depends for its operation on its unilateral conductivity, whereby current can pass through the tube only from the cold elec-

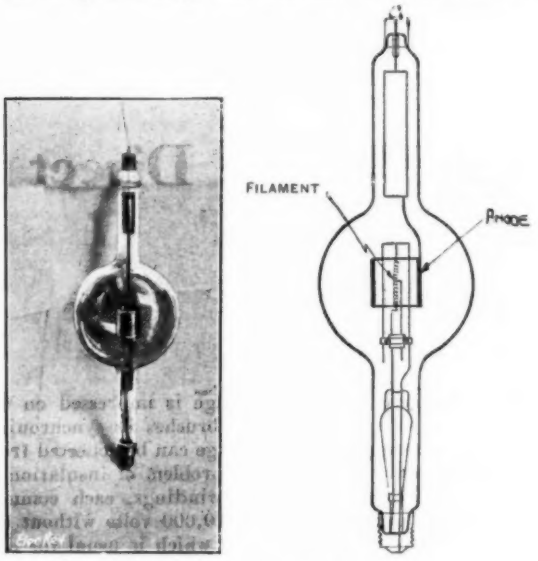


Fig. 3.—A Kenotron Valve Rectifier.

trode (the plate) to the hot electrode (the filament), the current being due to the emission of electrons by the heated filament and their attraction to the positively charged plate.

The elementary circuit shown in fig. 4 indicates how half-wave rectification can be obtained. Such an arrangement is widely used on the Continent for making periodic tests up to 100,000 volts d.c. of complete underground cable systems, but it has the definite disadvantage that the resultant voltage and output-current waves may show very pronounced ripples, since they depend on one half of the alternating-current wave being

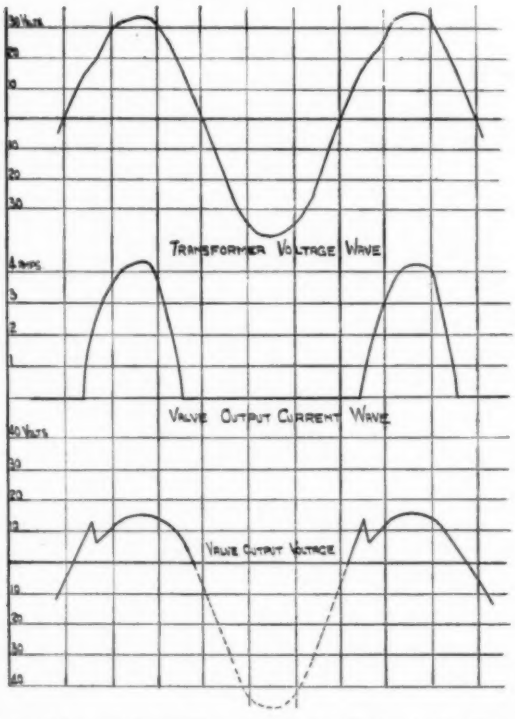


Fig. 5.—Voltage and Current Waves; Low-voltage Single-valve Rectification.

entirely suppressed. This point is illustrated in fig. 5, which shows the voltage and current waves for a low-voltage valve rectifier of the above type.

Two-Valve Kenotron Rectifier.

The introduction of a second valve into the circuit eliminates the trouble due to ripples, and theoretical considerations, confirmed by oscillograph test records, show that the variation in the high-voltage d.c. may be

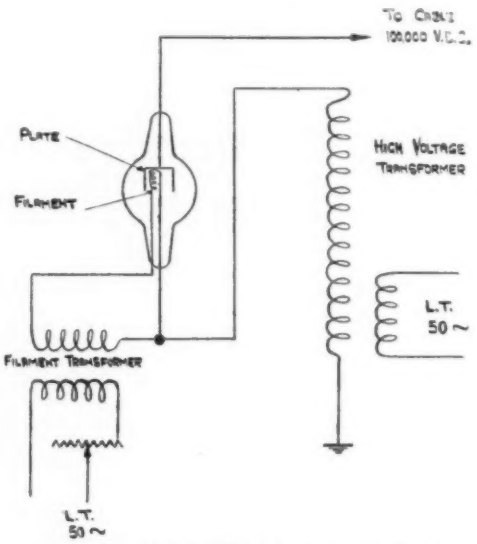


Fig. 4.—Half-wave Rectification; Elementary Circuit.

reduced to approximately 0.5 per cent., provided that the capacities and inductances in the circuit are suitably proportioned.

In ordinary commercial cases, using 50 cycles a.c.,

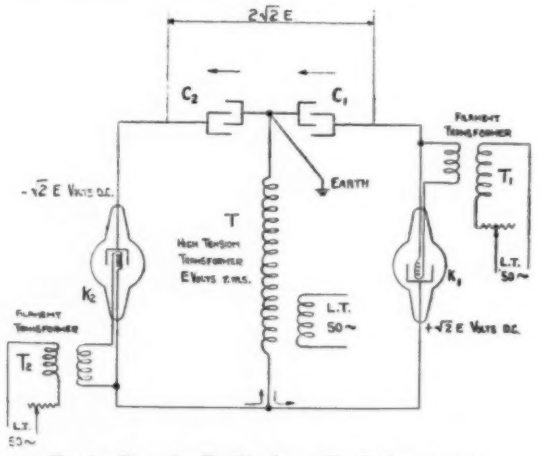
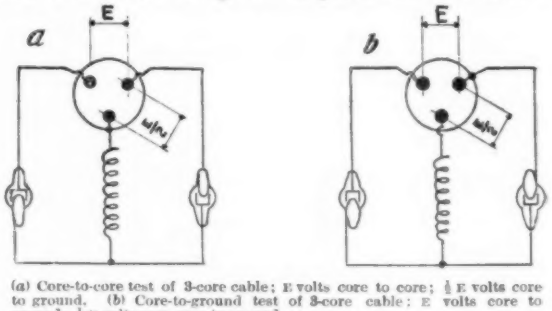


Fig. 6.—Two-valve Rectification: Circuit Arrangement.

the variation in the d.c. voltage will not exceed 5 per cent.

The arrangement of the circuit for two-valve rectification is indicated in fig. 6. Step-down transformers T_1



(a) Core-to-core test of 3-core cable; E volts core to core; ½ E volts core to ground. (b) Core-to-ground test of 3-core cable: E volts core to ground; ½ E volts aux. core to ground.

Fig. 7.—Test Connections; Two-valve Rectification.

and T_2 supply current for heating the filaments, while a step-up transformer T supplies high-voltage alternating current to the rectifier. The circuit is unidirectional in

the sense that it permits only the positive half-waves to pass through Kenotron K_1, thereby charging condenser C_1 to $+\sqrt{2}$ E volts d.c., and only the negative half-waves to pass through Kenotron K_2, thus charging condenser C_2 to $-\sqrt{2}$ E volts d.c. Thus a direct-current voltage $2\sqrt{2}=2.8$ times that of the transformer is set up across the outer terminals of C_1C_2. In practice, however, various losses occur, and a rectification efficiency of only 85 per cent. is obtainable, reducing the d.c. to a.c. transformation ratio to approximately 2.4.

Connections of Kenotron Rectifier for Cable Testing.

The two important tests which are specified for high-voltage cables after installation are, first, core-to-core tests on three-phase cables, and secondly, core-to-earth tests on three-core or single-core cables. Fig. 7 (*a*) shows the connections for the former test, in which the condensers C_1 and C_2 are replaced by the internal capacities of the cable. It is inherent in the apparatus that for a given test voltage between cores, a half voltage is built up between cores and earth. Thus if E is the specified test voltage between cores as shown in fig. 7 (*a*), the core-to-earth voltage is E/2.

Fig. 7 (*b*) illustrates a core-to-earth test at the full voltage of the set (half voltage between auxiliary core, not under test, and earth).

Conclusions.

(1) The Delon type of rectifier produces transients of such high voltage as to cause very severe, and probably injurious, stresses on the cable.

(2) The two-valve Kenotron portable high-voltage rectifier can be used very efficiently and conveniently for applying d.c. integrity tests to cables after installation, and the transients produced by the Delon apparatus are avoided.

The Electrical Industry in Germany.

THE above is the title of a special publication which has been issued by the British Electrical and Allied Manufacturers' Association, covering 152 pages of text and many tables, and representing the results of an investigation showing the strength of the forces which German competitors can array against British firms, and the lines along which German organisation for production and marketing is now developing.

The first section of the work recalls the fact that the reparation payments made last year were met by borrowing operations abroad either in the form of Government or industrial loans, but this year the burden begins to fall more directly upon Germany herself, and in 1927-28, when the amounts are to be 1,750 millions of gold marks, the larger payments should begin to test the Dawes plan to the utmost. As the country is borrowing abroad for her own requirements, Germany will continue to have an adverse balance of trade until this situation is remedied. Germany is the first intensively-industrialised country in the world to become a debtor nation, and in order to obtain an export surplus she will have to adopt a policy of deflation which will bring about a catastrophic fall in prices; apart from political repercussions in Germany itself, this fall will adversely affect the export trade of Great Britain. On the whole, all the signs point to a stabilisation or a fall of prices in Germany; if the latter occurs, the gap between British and German costs of production should become still wider with harmful consequences to British export trade. There is no instance in history of a nation without a large reserve of foreign investments attaining an export surplus of £125,000,000 per annum—the amount of 2,500,000,000 marks to be paid in and onwards from 1928-29 by way of reparations under the Dawes scheme—but when the country is a debtor nation, the possibility of an export surplus of £150,000,000 is even more remote.

In the second section the reader learns that simultaneously with the execution of the Dawes plan and the financial re-organisation of Germany and German industry, the system of deflation has also been carried out in regard to the capital in circulation, the thorough cleansing process having led to a very conservative policy in evaluating the assets of the industrial undertakings and banks, which have emerged on a stronger financial basis than in 1913. The shortage of capital has been made good, partly through more effective financial control within the organisations themselves, and partly through loans obtained in New York, which latter have been used as a basis for obtaining short-term loans in Germany itself. If the balance sheets of the three chief electrical companies are examined, the effects of such a policy can be easily seen over the years 1923-24 and 1924-25. It is shown, for instance, how the loan capital has been used in improving the financial position of the three firms, thus justifying the theory that after the work of reorganisation, the improved financial position has allowed German electrical firms to launch out on a policy of expansion based upon increased output and a ready provision of credit.

Passing on from the question of taxation, of which the German basic industries have a lower burden than the British industries, we come to the question of electrical manufacturing. In this section it is shown that the turnover of the three main firms, amounting to from £40,000,000 to £50,000,000 per annum, is sufficient to indicate the grip which they have on the German market, and that by a mutual arrangement they could at once establish a trust and obtain a monopoly and bring the smaller firms within its sphere or into liquidation. Indeed, in a later section it is actually stated that preliminary negotiations are now under way for the formation of an all-German electrotechnical industries trust.

The work proceeds to deal with the financing of power supply through the manufacturing interests so as to ensure them a preference in the allocation of orders, and also in the matter of the electrical banks with their investment interests spread over a number of countries; with the new methods for the financing of contracts; industrial organisation and production in connection with coal, steel, and finished steel products; and statistics of electrical manufacturing in Germany and the foreign trade in electrical products, the latter in comparison with Great Britain, the United States, France, and Switzerland. After recording the movements which have already taken place in State activity in electricity supply, it is mentioned that the Government has now prepared an Electricity Bill, based largely on the English model, providing for the formation of a central electricity control with rights of assumption and control of supply works. On the whole, the tendency is to introduce State control and maintain private ownership, thereby combining or attempting to combine the best qualities of State and individual enterprise in industry.

Among other information contained in the work may be mentioned that relating to the extent of the electricity supply industry and that devoted to a consideration of prices and wages. The latter section points out that, in addition to the longer working week, German manufacturers also benefit from the low wages prevailing, these being from 30 to 40 per cent.

below the wages paid in Great Britain for the same class of electrical work. Working on the assumption that the distribution of production costs in a modern engineering works in Germany is the same as in Great Britain—a conclusion to which several investigators have come—the German manufacturers, through reductions in the prices of materials and wages, can quote 18 to 20 per cent. below the British manufacturer and still obtain the same ratio of profit.

The Conclusions of the Association.

The conclusions of the investigation may be summarised as follows:—

(1) The introduction of the Dawes plan has modified economic conditions so radically that historical comparison and analogy are practically useless for the comprehension of the vital factors affecting the present situation. The future of Germany lies with the success or failure of the Dawes plan, and the question arises whether the plan as at present framed will function until German indebtedness on the score of reparations has been cleared away. As far as can be judged for the moment, the continued success of the plan depends upon four possibilities: (*a*) That the wealth-producing capacity will be increased so greatly that the sum of £125,000,000 annually required for the scheme will be found from the national surplus; (*b*) that the intensive development of the natural resources will be so great that the adverse balance of trade existing before the war will be made good, and a surplus equivalent to the difference between £125,000,000 and the total of invisible exports be realised; (*c*) that the world market for manufactured goods will have increased so greatly that an additional £100,000,000 to £125,000,000 from Germany will be absorbed, or alternatively that displacement in the world market through intense competition of German firms will be such that manufacturers in other competing countries will yield ground to the extent required to give Germany an export surplus of £100,000,000; and (*d*) that the actual transfer of the sums required by the Dawes plan will not take place and that they will instead be invested in German industry and agriculture.

All four possibilities grade into each other. On examination, however, of all the factors bearing on the case the conviction prevails that none of the possibilities are capable of realisation without danger to British industry and the economic progress of this country as a whole; and it is considered essential for manufacturers to press for a drastic revision and even abolition of the Dawes plan in their own interests. The Dawes plan will reduce the standard of living in Germany, force deflation to a lower level than even now to encourage a surplus of exports, encourage a dumping policy by German firms, and cause a serious and permanent depression in the basic industries in Great Britain, including electrical engineering; and the process can even be seen at work now.

(2) The reorganisation of German industrial finance after a period of inflation to meet the requirements of stabilisation on a gold basis is now complete. The result of this has been an improvement in the ratio between capital invested and capital actually productive, and the position of the balance sheets is theoretically stronger now than before the war. On the other hand, the work of deflation has deprived industry of any surplus capital for extensions and developments, and it is compelled to market the production immediately or incur expensive loans to finance production. In heavy contracts and non-standard manufactures, however, where the turnover is slow and liquid resources are necessary to see the work finished, the German manufacturer is at a disadvantage.

(3) The effect of financial stringency has been most marked in the execution of orders generally, where financial accommodation stretching over a considerable period is necessary. Now the manufacturer cannot obtain short-term capital for long-term purposes owing to the diminished resources of the banks, and must be in a position definitely to redeem short-term bills on maturity, while the price of accommodation has become so high that his competitive position is seriously affected and his competitive ability has been seriously weakened.

(4) The effort to neutralise the effects of such a change has developed along the lines, as previously mentioned, of raising capital in the United States; the introduction of State credits at a rate of less than 2 per cent., which must be regarded as subventions; and the establishment of an export credit scheme.

(5) The organisation of German industry, or the methods of organisation hitherto adopted, have been changed to meet the new conditions imposed by the Dawes scheme and the resultant financial stringency. These are the disappearance or almost certain disappearance of the vertical combine (that is, controlling both raw materials to the finished products and finance); the creation of horizontal trusts as in the case of the United Steel Works (Ver. Stahlwerke) and the Dye Trust (the F.I.G.); the practical maintenance of the price cartels or associations; State participation in industries and the formation of trusts, special manufacturing companies for special branches of manufacture, and public supply undertakings to control the generation and distribution of power.

(6) The introduction of modern machinery is effecting a change in the economic situation. The whole field of production has been surveyed; inefficient and obsolete machinery has been scrapped, and a revision of labour is taking place in which human power is more and more fulfilling its proper function of control; and electricity is the instrument chosen towards this end. Such improvement is being carried out, not in a series of isolated instances, but as a result of a deliberate policy undertaken by the great industrialists who are profiting by the errors of the past, and it is resulting in the co-ordination of the national productive capacity into a coherent industrial machine of great and improving efficiency.

(7) Germany has practically recovered from the disturbances caused by political developments, and is now producing at about 90 per cent. of the pre-war average. Engineering generally is still depressed, but electrical manufacture now exceeds the pre-war output. The electrification of industrial processes has provided a steady demand, although in 1924 and 1925 it was still subnormal, while railway electrification, due possibly to electrical makers being strongly represented on the board of the Reich Railway Co., is being rapidly developed.

The home market has been active enough to allow electrical firms to adopt once more a policy of surplus disposal in the case of exports, and they are now competing abroad on a basis of factory costs without margins for profit, depreciation or capital charges. They are extending their hold on the European market and taking advantage of the improvement which has resulted in European trade conditions. In 1925 German electrical exports to European countries increased by 48 per cent. over those for 1924, and amounted to 70.5 per cent. of the total German electrical exports, whereas in 1913 the corresponding percentage was 71. Europe absorbs annually over £11,500,000 of German electrical goods and not more than £1,500,000 of British goods. Although the British total exports to European countries are higher now than in 1913, it is clear that there is still room for development of this market by British firms.

(8) The rapid growth of the power market has been such as to keep makers busy to 80 per cent. of their capacity and permit of the dumping of the balance on foreign markets.

(9) At present the British maker is at a disadvantage of 10 per cent. as compared with the German in so far as the purchase of raw materials is concerned, while the difference is about 20 per cent. in favour of the latter in regard to finished products.

(10) It is scarcely possible to avoid the conclusion that formidable industrial machinery is being tuned up by reorganisation preparatory to the biggest onslaught of modern times on the markets of the world.

The Power Supply of Wireless Sets.

By PAUL D. TYERS.

UNDOUBTEDLY the greatest deterrent to the universal popularity of the valve receiver is the question of power supply. After some three years of broadcasting the public finds that it is still necessary constantly to recharge accumulators, and renew high-tension batteries. This expense, insignificant as it may seem at the time, assumes quite considerable proportions during a year. It seems very unfortunate that with an abundant supply of cheap electrical power laid on to even the smallest houses in our towns and cities, it is not possible to utilise this source more generally. It is, of course, possible to obtain both the filament and high-tension supplies from the public electric lighting mains, whether the latter carry alternating or direct current, but the method is complicated, and is such that it is not universally applicable to every type of receiver; neither can it be said to be foolproof.

The first step in the use of the public supply is to be found in a number of high-tension battery eliminators, which have now been on the market for some little while. Where direct current is available, its employment for the high-tension supply is comparatively simple, necessitating only the use of a suitable filter, consisting essentially of a network of inductances and capacities. In the case of alternating current, some form of rectifier has to be employed, and for this purpose one device, which has now become well known, uses an ordinary three-electrode valve employed as a two-electrode valve rectifier.

Little attempt, however, has been made to utilise a public supply for filament heating. Here the problem is far more complicated, especially in the case of alternating current. A perusal of recent patents shows that a very large number has been taken out for schemes utilising alternating current for filament heating. In the writer's opinion, however, very few of them are suitable for universal adoption. A battery eliminator, to be of any commercial value, must be such that it can be connected to the mains and, at the same time, be suitable for use with any type of valve receiving circuit, irrespective of the circuit used, and the type of valves which are employed. When an attempt is made to run a receiving valve filament directly on alternating current, the chief difficulty is due to the very small thermal inertia of the filament, which gives rise to variation in filament emission, at double the frequency of the alternating-current supply. In order to compensate for this effect, very complicated arrangements have to be associated with each part of the valve circuit, and, accordingly, so long as the normal type of thin-filament valve is used, it does not seem possible that alternating current can ever be used directly for filament heating purposes. Another trouble which arises is that due to variation in grid potential, and phase relationship. So far as direct-current supply is concerned, the problem is more simple, the chief troubles being due to commutator ripple, and here again, the greater the thermal inertia of the valve filament, the less will be the interference from this source.

Engineers, however, are by no means regarding the problem as insoluble, and a considerable amount of experimental work is being carried out. The writer can safely say that the only satisfactory solution of the power supply problem will be that which constitutes a device which, when plugged into the mains, can be substituted immediately for the ordinary filament accumulator and high-tension battery, without necessitating any change in the wiring of a set or the use of special valves.

It is heard on very good authority that at least two new battery eliminators will make their first appearance at the forthcoming Wireless Exhibition at Olympia in September, and it will be very interesting to see how they are received by the public. It is believed, however, that they will be very expensive instruments, costing as much as a good wireless receiver, and will therefore appeal only to a limited number. Anyone who succeeds in producing some arrangement at a competitive price should be assured of a very ready market.

The Ignition of Firedamp by Momentary Flames.

A RECENT publication of the Safety in Mines Research Board, Paper No. 24, "The Ignition of Firedamp by Momentary Flames," contains two parts, one by N. S. Walls and R. V. Wheeler, and the other by W. Rentaul and A. G. White (H.M. Stationery Office, price 9d. net).

The first part contains a record of some investigations to determine the characteristics and conditions of existence of the inflammable mixtures of firedamp and air, and coal dust and air, which enable them to be ignited. A jet of inflammable gas was exposed during a measured interval of time to the mixture of firedamp and air in most of the experiments.

When a gaseous explosion occurs within a vessel that is completely closed except for a small orifice, a tongue of what appears to be flame, and is, at all events, luminous gas, is projected through the orifice.

It was considered that a measure of the relative ignitability of different mixtures of methane and air might be obtained by subjecting them to such tongues of flame (from a mixture of methane and air containing an excess of oxygen) shot from an explosion-vessel of constant capacity through orifices of different sizes, the idea being that, other factors remaining constant, the smallest tongue (from the smallest orifice), would only ignite the most readily ignitable mixture. A suitable apparatus was constructed for producing the required flame in the mixture, and the following are some results of a series of experiments, the figures in the second column being the smallest diameters of holes (64ths of an inch):—

Methane in Air. Per cent.	Relative Ignitability.
6.70	24
7.85	16
8.55	13
10.30	16
13.20	24

The final method adopted in an endeavour to differentiate one mixture of methane and air from another as regards its ignitability by flames, involved the mechanical bringing of the mixtures into contact with a flame during a measured small interval of time.

The general conclusion to be drawn from these experiments is that the mixtures of methane and air most readily ignited by flames, inasmuch as the time of contact required is shortest, contain between 9.5 and 10.0 per cent. of methane.

The tests show that the ignition of mixtures of methane and air does not occur instantaneously when they are exposed to a flame. There must be a definite duration of exposure, dependent on the character of the flame. From the fact that the mixtures of methane and air most readily ignited by fully oxidised explosives contain less methane than the mixtures most readily ignited by flames, it is suggested that the flame of an explosive is not solely responsible for its power to ignite gaseous mixtures.

Part 2 deals further with the ignition of firedamp-air mixtures by momentary flames.

Different flame mixtures were tried for exposing methane mixtures, and it was found that for each flame used a certain number of mixtures of methane and air require much the same time of contact for ignition, but that the range of such mixtures becomes narrower, and the mixtures contain less methane as the oxygen deficiency of the flame is increased.

The results show that the most readily ignitable mixture varies considerably with variation in the oxygen balance of the flame used for ignition. This is what might reasonably be expected when it is considered that the igniting gases and the methane-air mixture may interact to some extent before ignition.

Aluminium in Norway.—It is announced from Oslo that the five aluminium works now in operation in Norway are turning out 24,000 tons of metal per annum, giving occupation to 1,800 workmen. The extension of the production which is impending at the Glomsfjord and Kinsarvik seems to point to a still greater output in the future. All the Norwegian works are owned by three syndicates, which are said to be also owners of many foreign works.

Small Motors for Farms in France.—The Union des Syndicats de l'Electricité, with the support of the Ministry for Agriculture, the syndicate of makers of agricultural machinery, &c., is organising a series of controlled trials of small portable electric motors for use in connection with agricultural operations. The competition is restricted to French makers, and concerns motors of from 1.1 to 3.7 kW, single- or three-phase types.

Legal.

Collector Sentenced.

ACCORDING to the *Evening News*, C. W. Connell, a collector in the Finchley Council's electric lighting department, was, on August 11th, at Highgate sentenced to three months' imprisonment for falsifying the books of the Council. While it was stated that £400 was involved, Connell said that he had not taken more than £230; he added that the trouble began when he lost £60 in the street and failed to report the fact.

Alleged Long-Firm Fraud.

THE *Star* reports that on August 11th, at the Bow Street Police Court, Albert M. Davis, sales organiser, Rene G. Sturdy, clerk, William H. Bateman, clerk, and Albert E. Wilson, import merchant, were charged with being concerned together and with others unknown to defraud such persons as should supply them with goods. They were further charged with obtaining by false pretences goods to the amount of £34 from Fuller's United Electric Works; £15 from Messrs. E. A. Wilson & Co. (Birmingham); £15 from the Telsen Electric Co. (Birmingham); and £25 from Compactums (Regent Street). It was stated that the total sum involved was between £600 and £700 in respect of goods obtained over a period of five months. The hearing was adjourned for a week, bail in £100 being allowed for Bateman and in £400 for the other defendants. When the defendants were formally charged Davis said that he thought he had an explanation. Wilson denied knowledge of the others with the exception of Davis, with whom he shared an office.

Theft of Cable.

AT Darlington, on August 13th, Christopher Smith was charged with stealing a quantity of electric cable, value £2 2s., from the Darlington Corporation electricity works. An official at the works said he was informed that a piece of cable had been taken from the works by a man. When arrested, the defendant said he had taken it to get the money for rent. A fine of £2, or one month's imprisonment, was imposed. The defendant had been charged previously with theft.

Reviews.

International Critical Tables of Numerical Data: Physics, Chemistry, and Technology.—Vol. I. By EDWARD W. WASHBURN, Ph.D., Editor-in-Chief, assisted by eminent contributors. Prepared by the National Research Council, U.S.A. Pp. xx+415; illustrated. London and New York: McGraw-Hill Book Co., Inc. Price $12.

The volume under review is the first of five volumes of critical tables, and comprises an authoritative compilation of critically evaluated material prepared by a board of seven editors, together with fifty co-operating experts who are specialists in their subjects and exceptionally well qualified to contribute the sections allotted to them. In the preface Dr. Washburn, Editor-in-chief, describes in detail the guiding principles which have determined the scope and nature of this volume. In some respects the work is encyclopædic in character; whilst in some sections we find set out facts of quite elementary order, other sections are devoted to the most modern aspects of highly theoretical subjects. The orderly arrangement and exhaustive treatment of the material are outstanding features of the book.

The textual material covers all references up to the end of the year 1923. No attempt has been made to systematically cover the literature subsequent to that date, although a certain amount of information published since then has been utilised. The special value of the work lies in the fact that the data have been collected by some of the leading original workers in the various fields of science, who are men that can be trusted to be discriminating in what they collect, and who know from personal experience what is needed. The result of the collaboration of these experts is, as might have been expected, a volume which is replete with valuable information, including data of the most varied character collected from widely scattered sources.

The subject matter of this volume is presented in five sections. The first section deals with national and local systems of weights and measures, basic constants, and extensive data on the chemical and physical properties of elements and compounds. Tables are given covering the atomic weights of all the elements as officially determined since 1882, Aston's table of isotopes, together with the mass numbers in order of the intensities of the mass spectrum lines, Soddy's chart of the radio-active elements and a table demonstrating the electronic orbits of the elements. Fig. 4, page 51, is of outstanding interest; it consists of a schematic diagram of the orbits of the outer electron in the normal state of neutral atoms of the metals, copper, silver, and gold, and the alkali metals. The second section of the volume deals with thermometry, pyrometry, maintenance of constant temperatures, humidities, production of high temperatures, and good descriptive matter and data on manometry, psychrometry, and high vacuum technique. The chapter on standard buffer solutions and acid-base indicators, including the methods employed for the determination of pH values, is well written. There is also a highly interesting chapter on psychological data on errors of observation, including curves of relative visibility, absolute acuity and brightness, aural sensitivity, and reaction time for non-foveal stimulation.

The third section deals extensively with the physical properties of chemical substances, and is designed to serve as a source of ready reference for the approximate values of certain properties of chemical substances. This section covers pages 96-320, and is surprisingly complete, physical constants being given for over 6,000 organic compounds and over 3,000 inorganic compounds. Chapters are also included on the crystallography of carbon compounds, X-ray diffraction data, dispersoidology and odorimetry.

The fourth section consists of a complete discussion of radioactivity, including the physical properties of the radio elements, artificial disintegration, electron emission, radioactive radiation in gases, absorption and diffusion of beta rays in liquids and solids, and the distribution of radioactive materials in the atmosphere, hydrosphere, and lithosphere. The final section deals with astronomic, geodetic, and aerodynamic data. The stellar and nebular spectra are classified together with tables of stellar temperatures, masses, densities and diameters, with a short description of the general distribution of cosmic velocities. Orbital data of the solar system are given with selected characteristics of the members. The geodetic data include the figure, size, and density of the earth, with gravity data at over 400 selected stations. In the chapter on aerodynamics, tables are given of the dynamic pressures for indicated air speeds, correction for isentropic compression, wind pressure on structures, pressure distribution, air force on long struts and characteristics of airfoil sections. Considerable descriptive information is given on wind pressures on various forms of obstruction, surfaces, and propellers. We should have liked to call attention to many other features contained in this volume, but we hope to have indicated the wide extent of the ground covered and the successful and unwearying industry of the authors. There is no other work that gives such complete information on so many subjects, and the wide and extensive technical appeal of the volume also enhances its value and strengthens its position. The reviewer has but one criticism to register, namely, that the volume does not always distinguish sufficiently between formulas based on theory and those which involve some approximation or assumption. There can be no question as to the value of these classical tables, which will readily find a high place in the world of scientific literature.

Wireless Telegraphy: James Bowman Lindsay, and other Pioneers. By A. H. MILLAR, LL.D. Pp. xii+96; figs. 8. Dundee: Malcolm C. Macleod. Price 3s. net.

The author, who has written several books about Dundee and its historical associations, claims that James Bowman Lindsay, lecturer in science and mathematics at the Watt Institution, Dundee, and teacher in the Dundee Prison for 17 years, was the first inventor of wireless telegraphy. He did, in fact, give a public lecture on the electric telegraph on March 15th, 1853, in the course of which (as advertised on March 11th) he stated that submerged wires were not necessary for communication between Great Britain, Ireland, and France. He carried out experiments in the following month, and took out a patent for his method on June 5th, 1854. Briefly, his system consisted of a land-line ending in widely separated submerged plates, on either bank of the channel to be traversed; the water served to carry the current between the corresponding plates. He fully understood that the current would divide between the paths that were open to it, "in inverse ratio to their resistances." It is said that his greatest performance was telegraphing across the Tay where it was nearly two miles broad. He was thus early in the field, and great credit is due to him for his originality and perseverance. The system, however, had been tried by Samuel Morse in 1844, and we must regretfully withhold the title of "first inventor of wireless telegraphy" from Lindsay. The author's claim on his behalf that he proposed the system even in 1845 is untenable; the reference was explicitly to the use of the sea as a *return* conductor, which had been previously discovered.

The author gives an interesting account of Lindsay's career; like many of his fellow-countrymen, by industry and self-denial he rose from humble circumstances to a position of considerable eminence, and in later years received a Civil List pension in recognition of his attainments. He pursued the study of science and philology under great difficulties, and was a keen experimenter in the phenomena of electricity, for which he repeatedly prophesied a splendid future.

Hertha Ayrton, 1854-1923. By EVELYN SHARP. Pp. xvi+304; figs. 5. London: Edward Arnold & Co. Price 15s. net.

In this handsome volume the authoress gives a sympathetic account of the life and work of her friend, Mrs. Hertha Ayrton, whose name for 30 years has been a household word amongst electrical engineers; she was the first woman to deliver a course of elementary lectures on electricity to women, thus anticipating the movement which has culminated in the formation of the Electrical Association for Women; she was the first woman

to read a scientific paper before the Institution of Electrical Engineers (March 23rd, 1899), proving that the hissing of the arc was due to the access of oxygen to the crater; and she was the first woman elected a full member of the Institution. Her debut as a woman of science created a sensation which seems strange to us in these days, when woman has successfully invaded almost every sphere of our complex civilisation, but she was not alone—Madame Curie, who became her personal friend, having discovered radium in the previous year. As Miss Sarah Marks she early displayed originality and individuality to a notable degree; at Girton she invented a sphygnometer, and in 1884 she patented a line-divider, and decided to devote herself to science. Thus she became a student at Finsbury, and met her future husband, the late Professor W. E. Ayrton, who as a kindred spirit encouraged her scientific work; in addition to her researches on the electric arc, she studied the cause of ripple marks in sand, on which a paper was accepted by the Royal Society in 1915. Simultaneously she took a prominent part in the struggle for female suffrage, and during the war she invented the "Ayrton fan" for repelling gas attacks, the official treatment of which was a bitter experience, though after three years' strenuous efforts its efficiency was realised by the authorities—when the war was ending.

All these phases in a life of intellectual activity and industry, as well as the domestic and social aspects of Mrs. Ayrton's career, are faithfully recorded in this book, the excellence of which as a biography reflects the greatest credit on the authoress.

Correspondence.

***Correspondents should forward their communications* at the earliest possible moment.** *No letter can be published unless we have the writer's name and address in our possession.*

A Suggested Wireless Transmission Theory.

Referring to the article on "Wireless Transmission" by Charles E. Snell in the issue of the ELECTRICAL REVIEW for August 6th, I venture to suggest that the all-important factor in wireless transmission is its wave-length of propagation. The author in the article proves that longer distances of transmission are obtained during the night, as compared with daylight working. I suggest that this is only the case when long wave-lengths are used; for short wave-lengths, such as 40 metres and under, it is quite the reverse. Furthermore, for an equal amount of power at transmission, longer ranges of transmission are obtained with short wave-lengths during the day than with long wave-lengths during either day or night. My reasons for the above statements are as follows:—

The value of current in a receiving aerial is the dominating factor which determines whether or not it is possible to hear the signals transmitted by a distant station. If it were not for atmospheric interference, it would be possible, owing to the fact that present-day detecting apparatus is so sensitive, to hear signals independent of the magnitude of the current in the receiving aerial. It has been discovered that when a receiving aerial is tuned to a very long wave-length, atmospherics are detected as musical notes. Thus if we transmitted in the tens of thousands of metres (wave-length) our transmission would be very much affected by atmospherics, since the latter at long wave-lengths are of a musical pitch (assuming, of course, that the average transmitter has a musical note). A deduction from this is that the shorter the wave-length, the less is the atmospheric interference. Furthermore, as the author shows, atmospherics are more pronounced after sunset than during the day-time. Hence, summarising the above, we have:—

(1) That, were it not for atmospherics, we should receive all signals due to the great sensitivity of modern detectors.

(2) That atmospherics are fewer at short wave-lengths.

(3 That atmospherics are less during the day than night.

These three items, I suggest, tend to prove that greater distances of transmission—referred from the reception side—can be obtained during the day than during the night, using short wave-length transmission.

Thos. Barton, B.Sc. (Tech.)

Wigan, *August 7th*, 1926.

Electric Resistance Furnaces.

I read with much interest the article in the ELECTRICAL REVIEW of July 30th which deals with electric resistance furnaces, and particularly with that at Summer Lane, Birmingham.

I entirely agree with most of the statements made in the article, but I think it only right to point out that one set of figures is unduly optimistic. I refer to those quoted in Table 2 as the units required to anneal iron and mild steel. Taking a 1-ton charge and ignoring radiation and other losses, the actual power required to bring one ton of mild steel up to 800 deg. C. is 145.5 units.

The other figures given should be corrected *pro rata* in order to be accurate.

I am inclined to think that in getting out the table the writer has overlooked the fact that the specific heat of iron and mild steel is not constant at all temperatures. Actually it rises considerably, and reaches a maximum at about 875 deg. C.

The figures given in Table III I consider to be unduly pessimistic. They can certainly be reduced by 50 per cent. by the use of properly installed and sufficient heat insulation.

Hamlyn M. Drake,
Electric Furnace Dept.,
DRAKE & GORHAM, LTD.

London, *August 9th*, 1926.

The foregoing communication was forwarded to the authors of the article, who replied as follows:—

With reference to Mr. H. M. Drake's letter, it is realised that the specific heat of steel varies considerably with the temperature, and to a certain extent with the analysis of the metal. As we found different specific heats quoted by different authorities, a mean was deduced from the figures stated. It must be remembered that while the specific heat at 800 deg. C. is considerably higher than at room temperature, the average will be in its turn less than at 800 deg. C.

Regarding Table 3, these figures were obtained on test on the furnace installed at Summer Lane. The writers agree that by the use of additional insulation the figures would be considerably improved. This would, however, entail more units being required to raise the furnace from cold to the working temperature and a longer time being taken over the operation. On the other hand, owing to the greater amount of heat insulation used, the rate of cooling would be less throughout the night and the starting temperature next morning would be higher than that of the present furnace.

W. Y. Anderson, A.M.I.E.E.; W. P. Conley.

Birmingham, *August 14th*, 1926.

Radio Valves.

Simultaneously with the public Press announcements respecting the reduction in retail prices of valves made by the V.M.A., which will no doubt have been made ere this appears in print, the retail trade will look for announcements in the trade Press that all dealers holding stocks of such valves will be allowed rebates on their stocks.

To accord such rebate to dealers who, to the advantage of the manufacturers, make a point of carrying a stock of their valves, would seem to be an act of the barest justice; yet the trade recalls that on previous occasions of reductions in price the greatest difficulty was experienced in obtaining redress.

Not only would the decision to confine the rebates to retailers who, in consideration of an additional discount, have signed an agreement to sell only V.M.A. valves be unjust, but in view of the many excellent non-V.M.A. valves on the market any such action would certainly not be in the interests of the manufacturers themselves.

The trade will therefore look for an early assurance that on this occasion fair treatment will be accorded to all dealers whether under agreement with the V.M.A. or not.

On behalf of the General Purposes Committee,

Clifford & Clifford,
Hon. Secretaries, Wireless Retailers' Association of Great Britain.

London, *August 14th*, 1926.

Transformer Polarity Markings.

Your contributor, Mr. G. W. Stubbings, in his article on "Transformer Polarity Markings" in the issue of the ELECTRICAL REVIEW of the 12th inst., has evidently quoted B.E.S.A. Specification No. 72. This, however, has been withdrawn and superseded partly by Specs. Nos. 168, 169, 225, and 226. From these specifications, it is evident that the question of terminal markings, particularly for a.c. machinery, is still under discussion, so that the markings given in the article cannot be taken as settled.

That there is need for a definite ruling is evident from the fact that the markings given by Mr. Stubbings, namely—

$$\begin{matrix} T_0 \ldots\ldots T_1 \\ t_0 \ldots\ldots t_1 \end{matrix}$$

differ from those adopted by some manufacturers, who arrange the windings for a 3-phase unit as follows:—

$$\begin{matrix} C_0 \ldots\ldots C_1 & B_0 \ldots\ldots B_1 & A_0 \ldots\ldots A_1 \\ c_1 \ldots\ldots c_0 & b_1 \ldots\ldots b_0 & a_1 \ldots\ldots a_0 \end{matrix}$$

It is to be noted that the terminal markings of such transformers and of B.E.S.A. machines do not agree with the switchgear markings given in B.E.S.A. Spec. No. 158/1924, where phases are distinguished by the colours red, yellow and blue (R.Y.B.). A footnote to this specification (p. 7), incidentally, states that the use of other symbols, especially the letters A, B, C, should be avoided for switchgear connections.

Some difficulties in paralleling transformers are bound to exist as long as the terminal markings of a.c. machinery, transformers, and switchgear exhibit these differences.

J. Solomon, B.Sc., A.C.G.I.

Manchester, *August 16th*, 1926.

Business Notes.

Commercial and Industrial Developments, Business Changes, Trade Opportunities, New Publicity Literature, Liquidations and Failures.

E.D.A. Publicity.—We have received a batch of new publicity matter which has been prepared by the British Electrical Development Association. One leaflet shows that by using electricity in the household "Women's Work is Quickly done," while a neat booklet entitled "Those Borrowed Hours," attractively dwells upon the labour-saving advantages attending the use of electric fires on the chilly mornings and evenings of spring and autumn; a third discusses "The Economic Basis of Electricity Charges."

American Electrical Trade.—The Westinghouse Electric and Manufacturing Company, the second largest manufacturer of electrical equipment in the U.S.A., reports gross sales for the fiscal year ended March 31st, 1926, of $166,006,801, establishing a new high level. The net earnings were slightly below those for the preceding year; they were $14,122,001, or at the rate of $5.96 per share on the common stock. Addressing the company's meeting on June 6th (says the *Electrical World*), Mr. E. M. Herr remarked that business on the whole was rather better than was expected and was on the same basis as last year. The company had maintained a level value and now had a satisfactory load for its facilities. Due to seasonal conditions, they might expect a slight decrease in business during the summer months. Crop conditions in the fall would determine, to a certain degree, business conditions at that time. If crops were small, business would probably be on a lower level, although there would not be a large decrease even under adverse conditions.

The same contemporary says that the net sales billed by the General Electric Co. (America) for the first six months of the year ended June 30th, 1926, totalled $147,450,868 and the profit available for dividends on the common stock and surplus was $19,000,393. This announcement, which indicates net earnings equivalent to about $2.63 per share on the 7,211,481 shares of new no par value stock, was made by President Gerard Swope in accordance with a new plan of the company for reporting earnings quarterly to the stockholders, in addition to the statement of orders received which has heretofore been sent to stockholders every three months.

Bad Debt Insurance.—At a meeting of members of the Aberdeen Chamber of Commerce last week, Mr. A. M. Samuel, Parliamentary Secretary to the Department of Overseas Trade, explained the Government's proposals for the insurance of bad debts in export trade. Under the system, he said, exporters would be able to insure their risk up to 75 per cent. of the credit granted to their foreign customers by payment of a small premium. That, it was hoped, would enable British manufacturers to give the long-term credits which were so necessary if they were to secure foreign orders. The scheme was an experiment, and the Government hoped that later the business would be taken up by the big insurance companies.

Lead.—Messrs. James Forster & Co., reporting on August 14th, stated:—"Closing prices yesterday were £32 8s. 9d. for August and £32 2s. 6d. for November, a fall on the week of 2s. 6d. per ton The week opened with a firmer tone and by the 10th lead had reached £33, and November £32 13s. 9d. Since then there has been a sagging tendency. The market has been mainly professional this week, with consumers taking little interest. Arrivals are still on the light side but, on the other hand, consumption is not so good, probably due to the continuation of the coal dispute and the growing difficulty of obtaining coal supplies. The future is obscure and largely depends on whether the recent improvement in demand from Germany is maintained. So far as America is concerned, consumption there appears quite well able to look after production, while in this country an early settlement of the coal dispute could not have other than a beneficent effect on consumption with an improved demand."

Australian Tariffs.—In the House of Representatives, on August 11th, Mr. Pratten, Minister of Customs, moved higher General Tariff duties on several important foreign (not British) items of iron and steel manufacture. The Intermediate Tariff rates are also to be increased, but the increase will not be operative in the "reciprocal" trade relationships now existing with the other Dominions. The Minister explained that the increases were due to attacks by foreign steel interests, which placed domestic industry in a precarious position.—*Reuter.*

Wages in the Engineering Industry.—At a conference of the trade unions concerned in the demand for a general increase of 2os. per week in the wages of men in the engineering industry, held on Tuesday last, it was definitely decided to abandon the matter. The claim was put forward over two years ago, and the reason for its abandonment is the depressed state of the industry which renders such an increase impossible.

Deed of Assignment.—M'ELENY & RUSSELL, 26, East Shaw Street, Greenock. Trustee, Mr. H. Burt, 17, West Blackhall Street, Greenock. Claims to be sent to the trustee forthwith.

Russo-German Activity in Afghanistan.—It is stated that the Russian Electrical Trust proposes to enter into communication with the Berlin A.E.G. with regard to the establishment of electricity works in Afghanistan. The works would be financed by the Russian State Bank.

Bankruptcy Proceedings.—LAURENCE ARTHUR WOODHEAD, trading as L. Woodhead, 25a, Charles Street, Bradford, wireless dealer.—This public examination was held on August 9th, at Bradford. The statement of affairs showed gross liabilities of £454, of which £411 was expected to rank, with a deficiency of £248. In answer to questions, debtor stated that he was formerly a shorthand-typist, and turned gardener on account of ill-health. In 1917, after a course of instruction at a wireless school, he was posted as wireless operator in the Royal Naval Transport Service, and after the war, to the merchant service. In 1924 he began business as a wireless dealer with £214 capital. Debtor said that in the wireless trade the majority of the manufacturers had a price maintenance clause, and he had endeavoured to uphold it. Some firms had not tried and had sold at prices with which he could not compete. Lack of capital was another reason for his failure, but he was reminded that he had taken capital out instead of letting it remain in to work the business with. He further stated that he had to sell articles at a loss. The examination was closed.

JOHN HENRY DOLLITTLE, trading as the Zenith Radio Manufacturing Co., Virginia House, Portsmouth Road, Guildford, and 17, Park Street, Guildford, wireless engineer.—The first meeting of creditors was held on August 11th, at the offices of the Official Receiver, 29, Russell Square, London, W.C.1. A statement of affairs was presented which showed liabilities of £631, all due to unsecured creditors, and net assets of £92, leaving a deficiency of £539. It appeared that in September, 1922, the debtor commenced business as a toy dealer, but was not successful, and in January, 1925, he sold off his stock at a considerable loss. He then commenced trading in wireless goods under the name of the Zenith Radio Manufacturing Co., but that venture was also unsuccessful. The debtor admitted that he was in difficulties two years ago, since when all the debts had been incurred. A creditor asked if the debtor had any proposition to make, and in reply the debtor said he was hopeful of being able to put £4 per month aside for the creditors if the business could be continued. The Official Receiver pointed out that he (debtor) could not do that unless he or someone else were prepared to buy the assets. The case being a summary one, was left in the hands of the Official Receiver as trustee. The following are creditors:—

	£		£
Dew, A. J., & Co.	43	Rice & Harper, Ltd.	45
General Electric Co., Ltd. ...	41	S.D.H. Manufacturing Co. ...	25
Gorrill, H. W. J., & Co.	50	Watson, Jones, Ltd.	80
Kendrick, A.	50		

NORMAN LESLIE CRAWLEY, lately of 90, Three Colt Street, Limehouse, E., electrician.—Creditors met on August 13th at Bankruptcy Buildings, Carey Street, W.C., under the failure of this debtor, against whose estate a receiving order was made on July 27th, at the instance of a creditor. The Official Receiver reported that the debtor had not attended under the proceedings and was believed to have gone abroad. An inspector attended at the above address and had reported that he was informed that the debtor sold the business last May. Proofs amounting to £319 were admitted and the case was left with the Official Receiver to be wound up in bankruptcy.

COX & SANTOLINI,, electrical and mechanical sign makers, 179, Old Street, E.C.—The first meeting of creditors was held on August 11th, at Bankruptcy Buildings, Carey Street, W.C., under a receiving order made against Wm. Henry Cox and Julien Marius Santolini, trading in partnership as above. The debtors entered into partnership in February, 1925, with capital provided by the petitioning creditor (Mr. Walter A. Cox); the trading was unsuccessful from the outset and came to an end when Mr. Cox issued a writ for the recovery of his debt and instituted these bankruptcy proceedings. Accounts were presented showing liabilities of £473, against assets of £10, and in the absence of any offer the estate was left with the Official Receiver to be wound up in bankruptcy.

R. C. J. WARNER and S. R. PEARCY, trading as Warner and Co., electrical and radio engineers, 28, Hill Street, Poole, Dorset.—The public examination of these debtors was held recently at the Law Courts, Bournemouth. The statement of affairs disclosed liabilities of £213, against assets of £26. Debtors' failure was attributed to want of capital, heavy expenses, and bad trade. It appeared that the debtor Warner commenced business in January, 1924, his parents advancing £65. In the following February he joined Pearcy, a motor engineer, who contributed no capital. They purchased a radio business for £115, that amount being advanced by Warner's parents, and later £50 was advanced. The business was not successful, and several executions were paid out. Warner said that the business had not afforded sufficient to pay costs and living expenses. He said he owed his parents £230. Pearcy agreed that he had not put any money into the business, and that he had been drawing out all the time. The examination was closed.

E. D. S. MUNDAY, 272, Lake Road, Portsmouth, Hants., electrical engineer.—The first meeting of creditors was held on July 29th, at the Official Receiver's office, 87, High Street, Portsmouth, when the case, being a summary one, was left with the Official Receiver as trustee.

MRS. J. A. M. JAMES (Fuchsia-phones Installations), wireless dealer, 9-11, Mill Street, Middleton, Lancs.—Receiving order made August 6th, on debtor's own petition.

G. C. BARNES, electrical engineer, Regent Electrical Works, Royal Street, Barnsley.—First meeting held August 18th, at the Official Receiver's office, County Court Hall, Barnsley. Public examination held August 19th, at the County Court Hall, Barnsley.

T. N. SHEPHERD, plumber and electrical engineer, 15, Bridge Road, Stockton-on-Tees, and 5, Queen Street, Redcar.—First and final dividend of 3s. 2½d. in the £, payable August 25th, at the offices of Messrs. Poppleton, Appleby & Turner, 155, Norfolk Street, Sheffield.

Company Liquidations.—P. ADAIR, LTD., wholesale electrical and wireless distributors, 32-34, Holborn Viaduct, London, E.C.1, and at Glasgow, Manchester, and Newcastle-on-Tyne.—A meeting of creditors was held on August 11th, at the Institute of Chartered Accountants, Moorgate Place, E.C. The chair was occupied by Mr. W. H. Bevan, C.A., of 182, Temple Chambers, London, E.C., the liquidator of the company. The statement of affairs presented showed liabilities of £12,387, all of which were due to unsecured creditors. The assets were estimated to realise £4,760, from which had to be deducted £186 for preferential claims, leaving net assets of £4,574, or a deficiency so far as the creditors were concerned of £7,813. The assets included book debts £4,178, expected to produce £3,000, and stock at cost £1,280, estimated to realise £750. The liquidator stated that the stock was held partly in London and partly at the branches in Glasgow, Manchester, and Newcastle.

Mr. Bevan reported that the company was formed in October, 1922, to acquire from Mr. P. Adair the business which he had previously carried on as a dealer in electric lamps and accessories. The tangible assets taken over consisted of stock, cash, furniture and fittings, £338, and the total purchase price was £488, the difference representing the goodwill of £150. The consideration paid to the vendor was the allotment of 488 shares of the face value of £1 each. The nominal capital of the company was £500, and the remaining 12 shares were allotted for cash. The company was able to trade successfully up to about February, 1925. The turnover during the four months to February, 1923, was £8,200, or approximately £25,000 per annum. During the twelve months to February, 1924, the turnover increased to £30,000, and in the following year it went up to £39,000. For the year to February, 1925, the net profit, after charging Mr. Adair's salary of £1,000, was £1,510. Up to that time the company had been dealing principally in electric lamps for motors, purchased from abroad. A balance sheet dated February, 1925, showed that the company was then in a fairly healthy position. The assets included cash, £3,300; book debts, £7,300; and stock, £1,040, whilst there was a credit balance on the profit and loss account of £1,844, after bringing in the share capital of £500. About that time the suppliers gave notice to terminate their contract with the company. Mr. Adair had then to decide whether he would seek another source of supply or join the Electric Lamp Manufacturers' Association. Eventually he decided on the latter course. Up to 1925 the business had been carried on in London, but it was then decided to start branches in various parts of the country. Most of the branches were started about August of last year. In December, 1925, he (the chairman) was asked to report on the position of the company. He prepared figures and ascertained that between March and December, 1925, there had been a net loss of £734. In the period six branches had been opened. So far as the branches were concerned the net profits were not high, but that was probably due to the fact that they had only recently been commenced. He reported that the introduction of further capital was necessary, and if that was not possible the company's activities should be restricted so far as credit was concerned, and that it should work as largely as possible on a commission basis. Efforts were made to obtain further capital, but it was not forthcoming. The position at the end of last year was not hopeless, more especially as it was believed that when the branches were got going thoroughly they would prove profitable. However, when the accounts for the twelve months to February last were completed it was ascertained that on a turnover of £25,000 there was an actual net loss of £3,656. On further investigation it became apparent that the opening of the branches was not justified by the results, and they were mainly responsible for the state of affairs which existed. The overhead expenses at the branches were too high having regard to the turnover, and in addition an increased staff in the London offices had been necessary. The four largest creditors, who represented approximately five-sixths of the liabilities, were consulted regarding the position, and several conferences were held. It was desired to ascertain whether it would be possible to avoid liquidation, and the principal creditors accordingly did not press. Expenses were cut down and certain of the branches closed, but eventually voluntary liquidation became inevitable.

Mr. P. Houstoun, of the British Traders' Association, said it appeared that some months ago the company consulted its principal creditors, who became aware of the position. The other creditors had not the same knowledge, and they had supplied goods on credit since.

Mr. W. Baker, of the Wholesale Traders' Association, said that one of the wireless firms which he represented had supplied goods to the value of £139 on credit since March, and had not been paid for them.

In answer to questions, the chairman said that the company had lost about £550 on investments. The company invested money in a small concern which did all the forwarding work, and also in a cable company.

Mr. Houstoun stated that at one time a mortgage was registered by the company, and it was satisfied in 1925.

The chairman said that when the company was registered it was thought that there might be some slight difficulty with regard to obtaining credit. A mortgage was therefore registered to cover any advance obtained from the bank. There never was, however, any overdraft at the bank, the debenture was never acted upon, and it should not have been registered.

Mr. Baker said the debenture was apparently wiped out, and he went on to ask how the present deficiency was made up, pointing out that after allowing for the loss on trading and the depreciation written off the assets in the statement of affairs there was a sum of something like £3,700 to account for. If that amount represented losses on trading since March then the company had been trading at a loss of between £150 and £200 a week.

The chairman replied that the company had probably traded at a loss, but in addition there were other items included in the figure mentioned. The stock had been written down and additional claims had been received.

The creditors eventually decided to confirm the voluntary liquidation of the company with Mr. Bevan as liquidator.

REFLEX RADIO CO., LTD., 198, Lower Clapton Road, E.5.—The report of Mr. J. Barwick Thompson, Official Receiver and Liquidator in charge of this company, has been issued to the creditors and shareholders. The winding up order was made last May and accounts have been submitted showing total liabilities of £3,151 (unsecured £1,832) and assets of £878, absorbed in the preferential and debenture claims. The deficiency as regards contributories is estimated at £1,984, the issued capital being £152 in ordinary shares. The company was registered as a private company on September 23rd, 1925, with a nominal capital of £1,000, and was formed to acquire as a going concern the business of wholesale factors of radio components, carried on under the style of "Reflex" Radio Company." The business had been carried on by Arthur Thomas and Robert Ernest Izzard since October, 1923, and was sold to the company for £1,150, satisfied by the issue of debentures for £1,000 and shares £150. The business was carried on successfully until January, 1926, when the demand for the reflex coil of which the company had obtained the sole selling rights and which had been the mainstay of the business, decreased, owing to the competition of a similar coil, and this resulted in the company trading at a loss. A debenture receiver was appointed in March, 1925, and carried on the business until May 27th last. He has discharged the claims of the bondholders and handed to the Official Receiver a surplus of £69, leaving assets to the value of about £300 to be realised by the latter official. The failure of the company is attributed to excessive competition, heavy cost of advertising, and delay in the delivery of the reflex coil plug at a time when there was a considerable demand; also to mismanagement and excessive expenditure. The following are some of the creditors :—

	£		£
Brown, S. G., Ltd.	47	Sterling Telephone & Electric Co., Ltd.	249
Greenleyt, Ltd.	215		
Igranic Electric Co., Ltd. ...	72	Wattson, Jones & Co., Ltd. ...	191
Lee, A., & Co.	29	Fully secured creditors	251
Nicholls, J. T.	541	Partly secured creditors: Barclay's Bank (sec. £145) ...	302
S.D.H. Mfg. Co., Ltd.	36		

RADIO PHONOPORE & ELECTRICALS, LTD., 58, Coleman Street, E.C.—The report of Mr. G. D. Pepys, Official Receiver, upon this company's affairs, has been issued to the creditors and shareholders. The accounts filed under the liquidation show liabilities of £13,486; assets valued at £3,468, and a deficiency of £14,117, with regard to contributories, the issued capital being £4,100 ordinary shares. The company was registered on January 12th, 1923, with a nominal capital of £5,000, for the purpose of carrying on business as manufacturers of telegraphic, telephonic, phonoporic and wireless instruments. It was promoted by Mr. Francis R. W. Robinson, who was receiver for debenture holders of Phonopore Construction Co., Ltd. (now wound up), which carried on business at the Phonopore Works, Southall, and he arranged for the sale to the company through Mr. E. W. White, of the assets of the Phonopore Construction Co., Ltd., for £5,400. That amount was paid to Mr. White by cheque and he handed the company his cheque for £4,900 in payment for 2,750 shares and 2,150 debentures. The business was carried on at the Phonopore works apparently without success, the trading accounts showing a loss of £3,358 from January 1st, 1924, to March 31st, 1925. The failure of the company is attributed to lack of capital and to the purchase of certain materials which proved unsuitable and prevented output, thereby causing heavy loss, in addition to the loss on the materials themselves. Mr. M. C. Spencer, C.A., 3, Fredericks Place, Old Jewry, E.C., has been appointed liquidator with a committee of inspection.

MIDLAND ELECTRICAL MANUFACTURING CO., LTD.—Winding up voluntarily for reconstruction purposes. Liquidator, Mr. A. A. Miller, Waterloo Street, Birmingham. A meeting of creditors is called for August 23rd, at the offices of Gibson & Ashford, 39, Waterloo Street, Birmingham. (This notice is purely formal; all creditors will be paid in full.)

Jenner Light & Power Co., Ltd.—Winding up voluntarily. Liquidator, Mr. R. H. McKerrow, 153, Worple Road, Wimbledon. A meeting of creditors was held on August 18th, at the Institute of Chartered Accountants, Moorgate Place, E.C. Particulars of claims to the liquidator by September 20th.

Premier Electric Welding Co. (Swansea), Ltd.—A meeting of members will be held at the offices of the Premier Electric Welding Co., Ltd., Harrow Manorway, Abbey Wood, S.E., on September 6th, to hear an account of the winding up from the liquidator, Mr. E. H. Discombe.

Private Arrangements.—The English Electric Wiring and Fittings Co., electrical engineers, 161, West Street, Sheffield.—A meeting of creditors was held recently, when the debtors' solicitor reported that the liabilities totalled £1,168, of which £718 was due to the trade and £450 to private loan creditors. The net assets were estimated at £284, leaving a deficiency of £884. It was stated that under certain circumstances the private creditors would not press their claims. The partners in the business were Messrs. H. T. Hall and A. A. Loveday, who commenced trading together in March, 1922. There was no partnership deed, but they were equal partners and introduced approximately £125 each as capital. The drawings had been moderate. The debtors had some good contracts on hand in connection with housing schemes, and they were desirous of completing them and carrying on the business. Some little time ago they required further capital, and decided to convert the business into a limited company. Negotiations were entered into with a third party in connection with which £2,000 would be found as capital, and preference shares issued, but the matter fell through. Then creditors began to press and the present meeting was called. On behalf of the debtors an offer was made of a composition of 10s. in the £, it being stated that monthly instalments of not less than £30 would be set aside for distribution *pro rata* amongst the creditors. Eventually a resolution was passed agreeing to accept the debtors' offer of 10s. in the £, payable by equal instalments at 4, 8, 12, and 15 months, subject to the cash creditors postponing their claims, and the last instalment to be satisfactorily guaranteed. It was also decided that the arrangements should be carried through under a deed of composition to be executed to Mr. C. Turner, of Messrs. Poppleton, Appleby & Turner, Sheffield, and that failing the carrying out of the scheme a deed of assignment should be executed. The following are creditors:—

	£		£
Drake & Gorham, Ltd.	12	Morley, T. B., & Co., Ltd. ...	23
Longmore Bros.	20	Adair, P., Ltd.	40
British Thomson-Houston Co., Ltd	25	Electrical Trades Supply, Ltd. ...	30
Allsop, G. W.	30	Claremont, Johnson & Co. ...	54
Coventry Electric Accessories ...	26	Electrical Cables, Ltd.	20
		Ratcliff, W. P., & Co	49

D. Howson and E. C. Ettrich, trading as Howson & Co., electrical and radio engineers, 2, Facade, High Road, Goodmayes.—The creditors interested herein were called together recently, when it was reported that the liabilities to the trade were £329, and there was a further liability outstanding of £142. The net assets were £245. It was stated that the business was commenced in August, 1925, when the assets of a radio business previously carried on by a limited company were purchased. The agreed price was £450, of which £230 was paid by Mr. Ettrich at the date of the purchase, and three post-dated cheques were given for the balance. Up to the moment only one of those three cheques had been met, and the vendors were creditors for the balance, less a small contra account. The vendors claimed that at the time of the sale an agreement was signed under which they had a lien on the goods which passed, and which might still be upon the premises. The latter were held at a rental of £75 per annum. Complete details of the trading were not available, but the sales appeared to have been in the neighbourhood of £1,300, although during the last few weeks the turnover had dropped to as low as £20 a week. Proceedings had been taken, and as one creditor was in a position to sign judgment, a deed had been executed to Mr. E. H. Hawkins, of Messrs. Poppleton, Appleby & Hawkins, 4, Charterhouse Square, E.C. A resolution was passed confirming the deed, and a committee was appointed.

Keith & Irwin, 35, Robertson Street, Glasgow, dealers in electrical supplies.—A meeting of creditors was held recently, at the offices of Messrs. Mackie & Clark, C.A., 124, St. Vincent Street, Glasgow, when a statement of affairs was presented which showed liabilities of £1,647, of which £1,215 was due to the trade and £432 to cash creditors. The assets were estimated to realise £261, leaving a deficiency of £1,386. The estate showed an apparent dividend of 3s. 2d. in the £. It was stated that the partners were Messrs. J. A. Keith and C. Irwin, who started trading together in June, 1922, with a joint capital of £400, contributed in equal shares. A balance sheet prepared on September 30th, 1924, showed that the capital had been reduced to £113, whilst a year later there was a deficiency on the capital account. Since September, 1925, there had been a loss on the trading of £579, exclusive of the total drawings of £300. During the latter period the sales had been £2,638, against purchases of £2,501. The present position was attributed to the continued depression in trade, and the small profits resulting from keen competition. There was no offer, and it was decided that the estate should be dealt with under a trust deed by Mr. H. Mackie, C.A., with a committee of three of the principal creditors.

Catalogues and Lists.—Carrington Manufacturing Co., Ltd., 18-20, Norman's Buildings, Mitchell Street, Central Street, London, E.C.1.—20-page illustrated price list of "Camco" cabinets and boxes for wireless apparatus.

Messrs. Gent & Co., Ltd., Faraday Works, Leicester.—Book 1, containing illustrated details and prices of electric bells, indicators, and accessories.

Messrs. I. Calvete, Ltd., 11, Little Saint Andrew Street, W.C.2.—Revised price list as from August 1st, 1926, for "Everay" high-frequency machines and accessories, vibrators, &c.

Messrs. L. G. Hawkins & Co., 30-35, Drury Lane, London, W.C.2.—Illustrated leaflet relating to the "Vio Ray" high-frequency junior model.

The British Thomson-Houston Co., Ltd., Rugby.—Five new publications in standard style and form:—D.S. 3312-1, Truck Type Ironclad Switchgear, Type T, form B4; D.S. 3313-1, Truck Type Ironclad Switchgear, Type T, form C2; Price List No. 5352-A, D.C. Motor Control Pillars with Drum Starters, Type CDP; Price List No. 5351-B, D.C. Motor Control Pillars with face-plate starting switch, Type CDP; Price List No. 7201-C, Fractional h.p. Motors for a.c. and d.c. circuits.

Messrs. Chas. Churchill & Co., Ltd., 9-15, Leonard Street, Finsbury, E.C.2.—A priced pamphlet dealing with the "Interlox" master measuring slide rule.

Dissolution of Partnership.—Encore Manufacturing Co., Ltd., manufacturers of wireless accessories, 16, Lower Richmond Road, Putney.—Messrs. H. W. Jackson and F. W. West have dissolved partnership. Mr. Jackson will attend to debts and continue the business under the same style.

Our Foreign Trade.—The following were the values of imports and exports of electrical goods and machinery during July:—

	July, 1926.	Inc. or dec.	7 months, 1926.
Imports—	£	£	£
Electrical goods and apparatus	288,505	– 2,582	– 381,367
Machinery	1,068,061	– 38,078	+ 568,078
(Electrical machinery)	104,622	+ 11,221	+ 42,302
Exports—			
Electrical goods and apparatus	1,092,122	+228,170	– 702,122
Machinery	481,293	+270,681	–1,727,605
(Electrical machinery)	528,322	+ 92,523	– 198,281
Re-exports—			
Electrical goods and apparatus	16,635	– 6,150	– 52,082
Machinery	123,989	– 24,268	– 104,386
(Electrical machinery)	9,000	+ 4,114	+ 10,405

Unemployment.—There was an increase of 13,380 in the unemployment total during the week ended August 2nd, the number at that date being 1,618,800. This compared with 1,260,400 on August 3rd, 1925.

Valve Price Reductions.—The General Electric Co., Ltd., announces that as from August 16th the prices of certain of its "Osram" valves have been reduced.

For Sale.—The directors of the British Lighting and Ignition Co., Ltd., Birmingham, invite offers for the business and assets of the company as a going concern. Messrs. Fuller, Horsey, Sons & Cassell will sell by auction, at the Baltic Exchange, E.C., on September 14th, the rolling stock and equipment of the Never-Stop Railway (Wembley), Ltd. (See our advertisement pages to-day.)

Copper, Lead, and Rubber Prices.—Messrs. F. Smith and Co. and Messrs. James & Shakespeare report, August 17th: No change in copper prices.

Messrs. James & Shakespeare report, August 17th: English pig lead, £34, 10s. dec.

Messrs. Edward Till & Co. report, August 17th: No change in the price of Para rubber.

Trade Announcements.—The business of Mr. J. E. Pearn, electrical and mechanical engineer, Sherwell Lane, Plymouth, is being carried on under the style of Pearn & Carson.

Credenda Conduits Co., Ltd., has removed to more commodious premises at Oldbury. Address: Credenda Conduits Co., Ltd., Oldbury, Birmingham. Telephone: Oldbury 401: telegrams: "Credenda, Birmingham."

Ceag, Ltd., has been formed to take over the existing business of the "Ceag" Miners' Supply Co., Ltd. The change is only a formal one, and no alteration will take place in the management and organisation of the new company.

The Zenith Manufacturing Co., Willesden Green, asks us to state that it has no connection with the Zenith Radio Manufacturing Co. (J. H. Dollittle), Guildford, against which a receiving order in bankruptcy has been made.

Book Notices.—"*Journal* of the Institution of Electrical Engineers." Vol. LXIV. August, 1926. London: E. & F. N. Spon, Ltd. Price 10s. 6d.

"Sands, Clays and Economic Minerals for all Industrial Purposes." Pp. 32; figs. 6. Issued by Algernon Lewin Curtis, Westmoor Laboratory, Chatteris.—This book contains considerable information on the production of a wide range of sands and allied materials.

Chambers of Commerce in Constantinople.—Foreign Chambers of Commerce in Constantinople have received an order from the Police Headquarters to cease their operations as from August 12th.—*Reuter* (Constantinople).

Lighting and Power Notes.

Accrington.—YEAR'S WORKING.—The report on the working of the Corporation electricity undertaking (engineer, Mr. A. W. Clegg) for the year ended March 31st last, shows a total income of £79,412, as compared with £76,179 in the previous year. Working expenses increased from £39,405 to £45,896, leaving a gross profit of £33,516 (£36,774), to which was added a net dividend of £76 on invested sinking fund, making a total of £33,592. Capital charges absorbed £23,407, and there was a net profit of £10,185, as compared with £13,667 in the preceding year, which was carried to appropriation account with a balance from the previous year of £12,284 and distributed as follows: Works of a capital nature, £5,329; rate relief, £2,000; change-over reserve account, £500; balance carried forward, £14,641. The electrical energy sold increased from 13,901,583 to 15,380,817 kWh, and the maximum supply demanded from 7,400 to 8,150 kW. The average price obtained per kWh fell from 1.310d. to 1.234d.

Bedwas and Machen.—LOAN SANCTIONED.—The Urban District Council has received sanction to a loan of £6,136 for the Bedwas and Trethomas electricity scheme.

Bexhill.—YEAR'S WORKING.—The accounts of the Corporation electricity undertaking (engineer: Mr. C. A. Frost) for the year ended March 31st last, show a total revenue of £34,779, as compared with £30,102 in 1924-25. Working expenses were £22,439, as against £17,910, leaving a gross profit of £12,340 (£12,192). After meeting capital charges there was a net profit of £3,143, as compared with £3,709 in the preceding year. The sales of electrical energy increased from 1,470,012 to 1,787,146 kWh, and the average revenue obtained per kWh fell from 4.95d. to 4.65d. During the year a bulk supply from Hastings Corporation commenced, and two 750-kW motor converters were installed for this purpose. Two new 1,250-kW converters have been placed on order, and will be in readiness for the coming winter.

Continental.—RUSSIA.—The *Commercial and Industrial Gazette* reports from Leningrad that owing to the delay in the opening of the Volkhov hydro-electric power station, and the insufficient power provided by existing stations and fuel difficulties, the question of the supply of Leningrad with electricity is becoming more acute. The Elektrotok has been obliged to refuse all new subscribers, with the result that the urgent requirements of Leningrad concerns cannot be satisfied. It is feared that the position of the Leningrad industries may become very difficult in the autumn and winter when electricity is most required. In order to prevent an electricity famine in the Leningrad district the North-western Industrial Bureau has asked the higher authorities to confirm immediately the plan for increasing the output of the peat-burning power station Krasny Oktiabr to 100,000 kW, and to include in the plan for electrical construction next year a sum of 3,000,000 roubles for preliminary work in connection with the building of a new hydro-electric power station.—*Reuter's Trade Service* (Moscow).

POLAND.—The *Financial Times* reports that following upon the negotiations between the Polish National Economic Bank and the Ministry of Public Works with the American-European Utilities Corporation, with a view to the electrification of a part of the Polish territory, the latter Corporation has applied for a concession. The concession would probably include the electrification of the whole district from the Carpathians up to the Vistula and Warsaw, including the industrial districts of Lodz, Czenstochowa, Biels and the Coal Basin.

PORTUGAL.—In order to ensure a continuous supply of power to consumers, the Union Electrica Portugesa is erecting a steam-operated central station in Oporto to act as a reserve to the Lima hydro-electric station in periods of low water supply.

FRANCE.—La Société Alsacienne et Lorraine d'Electricité has secured a concession to establish a 12,000-V transmission line between Sundhouse and Bindernheim. The Société de l'Energie Electriques du Sud-Ouest is also establishing a 60,000-V line between Perigueux and Thiviers (Dordogne).

The Société d'Electricité de Caen proposes to establish a 13,500-V transmission line along the Argences-Moult local railway to supply electricity to the distribution system of the Syndicat d'Electrification du Canton de Dozule.

The French Government has recently granted concessions for the establishment of several new hydro-electric stations. The Société Meridionale de Transport de Force is to erect one on the River Aude at Carcanet (Aude); the Ballion-Favreau Co., one on the Ciron near Cossarieu (Gironde); and A. Giros & Cie. one on the Estaing at Barraque (Lower Pyrenees).

Doncaster.—LOAN.—Application is being made by the Town Council, for sanction to borrow £4,275 to cover the cost of providing an electricity supply to the Warmsworth Road (South) Housing Site.

Eastbourne.—LOAN SANCTIONED.—The Electricity Committee has received sanction to a loan of £43,500 for electricity purposes.

EXTENSION OF SUPPLY.—The Committee has under consideration a scheme for the supply of electricity to Crowlink Gap, which will cost £17,500.

Hull.—PROPOSED CHANGE-OVER.—At the request of the Electricity Commissioners the city electrical engineer has prepared a comprehensive scheme for the changing-over of the system of supply to meet future developments.

Ilford.—SUB-STATION PLANT.—The Electricity Committee is to seek sanction to a loan of £4,500 for plant for the Uphall Road sub-station.

LOAN SANCTIONED.—Sanction has been received to a loan of £20,000 for mains and services.

London.—HACKNEY.—Owing to the increased cost of generating electricity, due to the continuance of the coal stoppage, the Borough Council has decided to increase the charges for electricity by 10 per cent., as and from the current quarter ending September 30th next.

Lytham-St. Annes.—YEAR'S WORKING.—The accounts of the Corporation electricity undertaking (engineer, Mr. J. C. Fairchild) for the year ended March 31st last, shows a total income of £55,022, and working expenditure of £31,347, leaving a gross profit of £23,675. The figures for the previous year were:—Income, £51,380; working expenses, £30,883; gross profit, £20,497. Capital charges accounted for £16,674, and there was a net surplus of £7,001. This was carried to appropriation account, together with a balance of £6,577 from the preceding year, making a total of £13,578, which was distributed as follows:—Rate relief, £3,688; reserve, £2,889; balance carried forward, £7,001. The capital expenditure during the year amounted to £29,979, the bulk of which was spent on mains. The consumption of electricity increased from 3,351,811 to 4,319,440 kWh. The average price obtained per kWh fell from 3.432d. to 2.671d.

Newport (Mon.).—NEW PUMPING STATION.—The Electricity Committee has approved the proposal to construct a pumping station for the utilisation of the waters of the River Usk for condenser cooling purposes in connection with the East power station at an estimated cost of £72,000.

Peterborough.—EXTENSION OF SUPPLY.—The Town Council has decided to give a supply of electricity to the sugar beet factory that is being erected at Woodston at a cost of £1,730, for a guaranteed annual minimum income of £325 for five years.

Price Reductions.—Reductions in the charges for electricity have been made or recommended in the following districts:—

QUEENSBURY.—*The Electrical Distribution of Yorkshire, Ltd.*—Lighting: From 6½d. to 6d. per kWh.

TAUNTON.—Lighting: First 500 kWh per quarter, 6d. per kWh; next 500 kWh, 5d.; over 1,000 kWh, 4d. Heating: 1½d. per kWh. Power: First 2,000 kWh per quarter, 2½d. per kWh; next 2,000 kWh, 2d.; above this amount, 1½d. per kWh.

DOUGLAS (I. OF M.).—Power: From 3d. to 2½d. per kWh. Cooking: From 2d. to 1½d. per kWh (on flat rate system); 1½d. to 1¼d. per kWh (on two-rate system).

Retford.—LOANS.—The Town Council has applied for sanction to loans of £7,600 for a generating station, and £3,275 for additions to the generating plant.

Sheffield.—YEAR'S WORKING.—We have received from Mr. S. E. Fedden, general manager and engineer of the Corporation electricity undertaking, a copy of his report, together with the statement of accounts for the year ended March 31st last. The total revenue amounted to £718,959, as compared with £773,037 in the preceding year, the falling off in receipts being due to reductions in the electricity charges which came into operation in March and September, 1925. Working expenses showed a slight increase at £332,777, as against £332,266, leaving a gross profit of £386,183 (£440,771), to which was added revenue from other sources, making a total of £397,817 available. After deducting interest and sinking fund charges, there was a net profit of £77,258, as compared with £48,808 in 1924-25. This was carried to appropriation account, together with a surplus of £5,970 from installation and motor account, and £73,446 transferred from reserve fund, and distributed as follows:—Rate relief, £60,787; works of a capital nature, £95,888. The capital expenditure during the year amounted to £179,892, and the total now expended on the undertaking stands at £4,160,783. The sales of electrical energy increased from 154,464,320 to 161,339,751 kWh, the maximum supply demanded from 72,356 to 76,804 kVA, and the total connections from 229,032 to 243,182 kW. The average price obtained per kWh fell from 1.186d. to 1.053d. During the year 122 miles of additional feeder and distribution mains were laid, making a total mileage of 907.

South-East Lancashire Electricity Advisory Board.—LEIGH.—The Engineering Advisory Committee has requested the Lancashire Electric Power Co. to submit details regarding transmission lines for the proposed bulk supply of electricity to Leigh Corporation.

MACCLESFIELD.—The Committee has received an application from the Electricity Company of Macclesfield, Ltd., for consent to install an additional 400-kW generator at its works, and also terms from Stockport Corporation for a bulk supply to the company. The matter has been deferred for further consideration.

ASHTON-UNDER-LYNE.—The question of extensions to the local generating station or a bulk supply from Manchester Corporation has been considered, and comparative figures have been submitted to the Electricity Commissioners. The Committee is of opinion that the station should be extended.

The minutes of the proceedings of the Engineering Advisory Committee have been approved by the Board.

South-West Midlands.—ELECTRICITY SUPPLY.—The h.p. transmission line, recently erected by the Shropshire, Worcestershire and Staffordshire Electric Power Company, from Kidderminster *via* Cookley through to Prestwood, is now completed and in operation. The company will be very shortly

giving its attention to systems of l.p. distribution in the villages of Franche, Cookley, Wolverley, Kinver, &c.

Special Orders.—Applications have been made to the Electricity Commissioners for Special Orders by the following authorities:—The Lancashire Electric Power Co., for the supply of electricity in the rural district of Leigh; the Peacehaven Electric Light and Power Co., Ltd., to supply in part of the rural district of Newhaven.

Straits Settlements.—SINGAPORE.—According to *Eastern Engineering*, good progress is being made with the erection of the new power station, which has been so constructed that if the need arises plant with a capacity of 40,000 kW can be installed. The present scheme only provides for 12,000 kW. With regard to the installation of plant, work is well in hand and a 2,000-kW set was expected to be in operation in June. Two more sets of 5,000-kW are to be installed.

Stoke-on-Trent.—SUB-STATION PLANT.—The Corporation Electricity Committee has approved a scheme for the equipment of the Tunstall sub-station at a cost of £7,500.

NEW TRANSFORMER STATION.—The Committee has decided to erect a transformer station at Burslem at an estimated cost of £4,000.

ELECTRICITY IN BULK.—The Corporation has referred proposals for bulk supplies to Uttoxeter and Congleton to the North-West Midlands Joint Electricity Authority.

Sunderland.—LOAN.—The Corporation has made application for sanction to the borrowing of £20,000 for mains and services.

Thornton-le-Fylde.—INAUGURATION OF SUPPLY.—A bulk supply of electricity for the town was formally inaugurated on August 13th. Electricity is obtained from Blackpool. Five transformer kiosks have been put into service, and about 14 miles of cables have been laid. Mr. W. P. Lilwall, electrical engineer to the Fleetwood Corporation, and consulting engineer for the scheme, stated that the number of consumers exceeded by 30 per cent., or 40 per cent., the number anticipated in the first instance, and it was predicted that within two or three years the concern would be on a profitable basis. He estimated that after 600 consumers had been connected it might be possible to reduce the price by ½d. per kWh.

United States.—HYDRO-ELECTRIC DEVELOPMENT.—According to *Power* four of the seven 50,000-h.p. water-wheel-driven generators which are to constitute the initial installation at the Conowingo plant of the Susquehanna Power Company are now being constructed by the General Electric Company. They are rated at 40,000 kVA, 90 per cent. power factor, and 13,800 V, with a speed of 81.8 r.p.m. An order for the other three machines has been placed with the Westinghouse Electric and Manufacturing Company. Four of the waterwheels will be built by the Allis-Chalmers Manufacturing Company and three by the I. P. Morris Company. Ultimately the plant is to contain eleven generators and will be capable of producing 1,360,000,000 kWh in an average year. Transmission to Philadelphia will be at 220 kV.

Tramway and Railway Notes.

Continental.—SPAIN.—A new section of the Metropolitan electric railway in Barcelona has recently been completed and put in operation. It is about 2¼ miles in length, and runs from the Plaza de Cataluna to Bordeta. The whole of the equipment and rolling stock of the new section is of Spanish construction.

BALEARIC ISLANDS.—The Compania de Tranvias has recently completed a new electric tramway between Palma and Establiment on the Island of Majorca.

BELGIUM.—It is reported that the scheme of re-organisation of the Belgian State Railways includes proposals for the conversion to electric traction of the most important lines, and in the first place those between Herbesthal, Liége, and Brussels, and between Brussels, Mecheln, and Antwerp. The works, it is stated, are to be carried out by German firms on reparation account.

GERMANY.—Work is approaching completion on a new electric tramway between Heidelberg and Wieblingen. It is also proposed to start operations shortly on the completion of a 5¼-mile line between Heidelberg and Schwetzingen, on which work was suspended during the war.

PORTUGAL.—*The Times* reports that the first electrified railway in Portugal, that between Lisbon and Cascaes, was opened on August 15th.

Glasgow.—RAILWAY ELECTRIFICATION.—Regarding a proposal to promote an Order in Parliament providing that, within a certain number of years, the railways within the city area be electrified, the Corporation Parliamentary Bills Committee has recommended that the application to Parliament be deferred.

India.—RAILWAY ELECTRIFICATION.—It is stated that satisfactory progress has been made by the G.I.P. Railway in providing quick transit between Victoria Terminus, Bombay, and the suburbs as far as Bandra and Thana. Through electric trains are now running between Bombay and Bandra *via* the Harbour Branch on the G.I.P. Railway. Electrification of the line as far as Thana is nearly complete, and electric trains have started running to Thana. It is hoped that the main line section from Victoria Terminus to Kurla will be open for electric traction by September 1st. It is expected that by the end of 1927 through electric trains will run from Bombay to Kalyan. It is hoped to extend the electrification programme, and complete it to Poona in 1929, and to Igatpuri some time in 1930. A special advantage of the latter scheme will be that the Bhore Ghats and Thul Ghats will be negotiated at much higher speeds than is possible by steam traction at present, and there will be substantial saving in time in journeys to Poona and Nasik.—*Indian Railway Gazette.*

London.—ACCIDENTS.—On Friday evening last (August 13th) an electric train from Shepperton was running into Waterloo station when the third coach fouled the points and left the rails, derailing the three succeeding coaches. None of the passengers was injured, but the permanent-way was badly torn up.

A collision occurred between a motor-omnibus and an L.C.C. tramcar on the same evening on Westminster Bridge. The driver of the omnibus, in trying to avoid a taxi-cab, ran on to the tramway line and the tramcar ran into it almost head-on. The omnibus was wrecked, and all the windows of the tramcar were shattered. A number of passengers received injuries, and were conveyed to the St. Thomas's and Westminster Hospitals, several being detained at St. Thomas's.

Thornaby-on-Tees.—EXTENSION OF TIME.—The Minister of Transport has made an Order authorising the extension of the period for the completion of works under the Thornaby-on-Tees Tramways Order, 1919, to August 15th, 1927.

United States.—CHICAGO.—According to *Electric Traction*, the Illinois Central Railroad has announced that the first electrified service of Chicago suburban trains commenced on August 7th. It will require about 30 days in which to completely change over from steam to electricity.

A new company has been formed, known as the Chicago Tube Transit Company, to construct a network of suburban lines connecting Waukegan, Illinois, and intermediate points to Joliet, Illinois, and Gary, Indiana, on the south with Chicago lines. The construction will include subways within the city limits, and operation will be carried over steam railway track wherever possible.

Telegraph and Telephone Notes.

France.—THE TELEPHONE SERVICE.—It is reported that a plan is under consideration to issue a loan to France, using the Paris telephone system as security. The funds would be used for pressing Governmental requirements and, if floated, it is expected that international telephone interests would back the loan. Large projects for the extension of telephone and telegraph ownership are believed to be afoot, and the French project would simply be an additional step thereto.

EIFFEL TOWER SERVICE.—M. Escudier, president of the Parliamentary group of the French Wireless Association, has addressed to the Minister of Commerce a letter drawing his attention to the fact that the Eiffel Tower wireless service has been placed in the hands of a receiver, following the incarceration of the concessionnaire, Stavisky, a Russian subject, on charges of alleged fraud. The group demands that measures be taken by the Ministry to assure the regular functioning of this service and the prevention of similar incidents in future. The *Financial News* states that Stavisky, who is alleged to have been associated with a company for exploiting the wireless station at the Eiffel Tower for a news agency, is endeavouring to have that wireless station placed under sequestration. He has made an application from his prison cell for a sequestration official to be appointed.

Germany.—NEW BERLIN 'PHONE EXCHANGE.—With the completion of the new telephone exchange in Berlin, it will be possible for subscribers in Berlin and Hamburg to obtain immediate connection with each other without using the "trunk" exchange.

Holland.—WIRELESS COMMUNICATION WITH AUSTRIA.—The Dutch Minister in Vienna, Jonkheer Van Nispen tot Sevenaer, officially inaugurated on August 9th a wireless-telegraph service between Vienna and Amsterdam. A few minutes after communication was established, Vienna transmitted its first telegram.—*Reuter* (Amsterdam).

Law Conference.—RADIO-TELEGRAPH CONTROL.—The International Law Association Conference opened in Vienna, Austria, on August 10th. Lord Phillimore presided. According to *The Times*, the report of the Aerial Law Committee, of which Mr. H. F. Manisty, K.C., Recorder of Berwick, was chairman, pointed out that next spring a conference of the Powers would be held in Washington with regard to technical matters arising out of the use of the ether for wireless messages in peace time, and the Committee came to the conclusion that any concrete proposals on the problem of "interference" would be premature. It recommended that the principle of control of the ether should be incorporated in any wireless convention; that sanctions should be laid down, to be adopted in the municipal law of each contracting country, for enforcing obedience to international regulations

embodied in the convention; and that any international dispute arising out of such convention be justiciable by the Permanent Court of International Justice at The Hague. Upon the doctrine of air sovereignty *usque ad coelum* as applied to the use of the ether for wireless, the Committee was divided. As regarded wireless in war, it came to the conclusion that it would be premature to make any recommendations in view of the rapid development of wireless.

The recommendations of the Committee were adopted with unanimity, with the amendment that the principle of air sovereignty as laid down in the 1919 Aerial Navigation Convention should in any future drafting embrace wireless also.

The Telephone Service.—LIVERPOOL FIRE ALARMS.—Liverpool has decided to spend £25,000 on the installation of a combined police telephone box and fire-alarm system. In addition to the customary alarm button, reached by breaking a glass case, each alarm station will be provided with a telephone box, which will be kept locked. In the city the key will be carried by the constable on the beat, but in outlying districts it will be placed behind the glass; special details of fires can thus be given and police aid summoned, if necessary. It is proposed to erect more than two hundred of these alarm boxes, and the installation of the new system will take about nine months.

BURNLEY CORPORATION SYSTEM.—The Burnley Corporation's telephone system is undergoing a radical change, the old magneto system being replaced by a Relay centralised automatic installation, which will link up 83 stations.

Radio Notes.

Australia.—WAVE-LENGTH.—Suggestions emanating from Sydney and Brisbane that there should be a variation of the wave-lengths of the "A" class broadcasting stations in Australia have been investigated by the Postmaster-General's Department, and it is almost certain that a widening of the margins between the various stations will be agreed to. Another report says there is every possibility of the wave-lengths of the stations being so varied that all will be brought under 600 metres.

RELAY STATION.—A proposal was discussed at a meeting held at Ballarat (Victoria) which was called to consider a proposed relay station in the city. It was eventually agreed that a public demand under the wireless regulations be made to the Postmaster-General for an additional "A" class station at Ballarat to relay the 3LO (Melbourne) service. One speaker said it would not be long before there were 250,000 licences in Australia. Victoria had 60,000 licences now which, after the payment of royalties and administrative fees, meant £60,000 a year to the broadcasting services. Melbourne had a wireless installation to every 17½ people; Ballarat had approximately one to 90. He added that a 500-watt station could be established for approximately £1,000.—*Reuter's Trade Service* (Melbourne).

Holland.—CURIOUS CONFLICT.—The radio broadcasting service in Holland is at present the subject of a remarkable political and religious conflict. The Netherlands station at Hilversum, one of the oldest stations in Europe, has always belonged to a private technical enterprise and was intended to advertise amateur activities. As this method turned out to be very expensive, it was proposed to close the station; thereupon a committee of listeners collected subscriptions among Dutch radio amateurs to pay the programme costs (fees, copyright, &c.). Meanwhile the organisation has still to bear all technical expenses, a situation that cannot last. More than once the Committee urged the Government at The Hague to regulate the matter by law, and *The Times* explains that Ministers in succession created Royal Commissions, composed mainly of political leaders, but the reports have been of so little practical use that the Government has been unable to base a Bill upon them. The matter, however, has become urgent in view of the International Radio Conference to be held at Washington in 1927. If (so it is argued) Holland does not adopt at once wave-lengths of between the margins allowed for broadcasting purposes by the Geneva conference, then the Netherlands will be unable to claim any useful wave-length. Wishing to rally enthusiasm for the sake of a really national service, the former Minister of "Waterstaat" (the Government office for dyking, posts, telegraphs, and telephones) composed his Royal Commission of representatives from all political and religious quarters. The Commission's report, recently published, has been severely criticised by the Press, yet it is the only base upon which his successor can found the Bill which he will introduce for regulating broadcasting in Holland. Last year the manager of the Hilversum station, yielding to pressure from the orthodox Christian (Protestant) group, consented to allow it a weekly transmission, which stimulated at once the formation of a Roman Catholic radio association and of a Social Democratic broadcasting group, each of which obtained one special sending evening a week. In consequence tendentious programmes are forced on the Dutch listener, and the lesser social, political, and religious sects are besieging the management with demands and requests.

Irish Free State.—LICENCE FEE REDUCED.—The Free State Department of Posts and Telegraphs announced last week that the licence fee for the use of wireless receiving apparatus, both valve and crystal sets, had been reduced from 20s. to 10s. a year. The new licences can now be obtained at any Post Office in the Free State at which money order business is transacted.

Spain.—RADIO CLUB AT ALMERIA.—A Radio Club has been formed at Almería. It will meet the cost of running the transmission station installed at the port. Trials at the new station, it is reported, have yielded excellent results.—*Reuter's Trade Service* (Madrid).

Contracts Open and Closed.

(The date given in parentheses at the end of the paragraph indicates the issue of the "Electrical Review" in which the "Official Notice" appeared in our advertisement pages.)

Open.

Australia.—MELBOURNE.—September 1st. Victorian Government Railways. Automatic sub-station equipment for Elwood sub-station. (B.X. 2598.)*

October 20th. Rail motor equipment. (A.X. 3449.)*

August 31st. Postmaster-General's Department. Telegraph equipment. (B.X. 2653.)*

September 14th. Telephonists' telephones and hand sets.

September 21st. Switchboard keys and parts. (B.X. 2669.)*

October 5th. Switchboard cords. (B.X. 2747.)*

October 12th. Automatic exchange equipment.

SYDNEY.—September 20th. Municipal Council. H.p. d.c. apparatus for cable testing.

October 18th. Two 100-ton electrical overhead travelling cranes. (A.X. 3467.)*

November 1st. Boiler feed pumps for Bunnerong power station. (A.X. 3470.)*

September 6th. New South Wales Public Works Department. Oil circuit breakers, Barren Jack hydro-electric development scheme.

Barnes.—August 23rd. Urban District Council. One 3,000-kW turbo-alternator, with condensing plant and auxiliaries. (July 30th.)

Belgium.—SCHAERBEEK.—August 27th. Municipal authorities. 5 kilometres of h.p. armoured cable. Particulars from Service de l'Electricité, Hotel Communal, Schaerbeek.

Coventry. — September 3rd. Electricity Department. Buildings, foundations, and subways, two 15,000-kW turbo-alternators, condensing plant and auxiliaries, water-tube boilers, complete with accessories, coal- and ash-handling plant, switchgear, pipework, crane, and cooling towers. (July 23rd.)

Croydon. — September 6th. Electricity Department. Two 50,000-lb. water-tube boilers and equipment. (July 30th.)

Doncaster.—August 31st. Electricity Department. One 6,000-kW, 3-phase turbo-generator, with condensing plant. (August 13th.)

Dunblane.—August 24th. Trustees of Victoria Hall. Electric lighting installation at the Hall. Schedules from Messrs. E. Simpson, McMichael & Davidson, architects, Stirling.

Dunoon.—August 31st. District Cottage Hospital. Electric lighting, &c., at new operating theatre, and other extensions. Schedules from Messrs. John Burnet, Son and Dick, architects, 239, St. Vincent Street, Glasgow.

Edinburgh.—August 30th. Association for the Provision of Hostels for Women Students. Electric lighting and power installations at two hostels. Schedules from Mr. Frank Wood, architect, 6a, George Street, Edinburgh.

Egypt.—CAIRO.—October 15th. Ministry of the Interior. Installation of electric power station equipment at Keneh and Luxor. (B.X. 2627.)*

September 15th. Electrical distribution system for Luxor. (B. 2738.)*

Grays. — September 6th. Grays Thurrock Electricity Department. One 250-kW rotary converter, with transformer, h. and l.p. switchgear, one 500-kW motor-converter, with h. and l.p. switchgear. (See this issue.)

Grimsby.—September 4th. Electricity Department. Ducts and l.p. feeder cables. (See this issue.)

India.—September 10th. India Store Department. Switchgear and auxiliary plant in connection with the G.I.P. Railway electrification. Forms of tender (20s.) from the above.

August 31st. 12,000 electric lamps. (See this issue.)

September 6th. Two 40-kW 240/480-V, 3-wire oil engine d.c. generating sets. (B.X. 2782.)*

Liverpool.—August 31st. Corporation. Supply and installation of a closed-circuit, code-signalling street fire-alarm and telephone system. (July 30th.)

London.—August 23rd. County of London Electric Supply Co., Ltd. Supply and erection of a central evaporating equipment. (July 23rd.)

METROPOLITAN ASYLUMS BOARD.—August 25th. Rewiring electric lighting circuits and installing main supply cable at Princess Mary's Hospital, Cliftonville, Margate. Installation of laundry apparatus at Woolwich Casual Ward. Covering with non-conducting composition steam pipes, &c., Park Hospital, Hither Green. (August 6th.)

LONDON COUNTY COUNCIL.—September 13th. Three water-tube boilers, with auxiliaries. (August 13th.)

August 30th. Electric goods lift and electric service lift for the Hackney Institute. (August 13th.)

September 6th. Electrical installation at the Hackney Institute. (See this issue.)

ST. MARYLEBONE.—September 13th. Works and Highways Department. Electric overhead runway for house refuse. Specifications from the Borough Engineer.

HOLBORN. — September 8th. Board of Guardians. Six months' supply of electrical fittings. Forms of tender from Mr. C. J. Cross, Clerk to the Guardians, 53, Clerkenwell Road, E.C.

WESTMINSTER.—September 1st. Board of Guardians. Electric lamps and fittings. Forms of tender from Mr. W. J. Lickley, Clerk to the Guardians, Princess Row, S.W.1.

Manchester.—August 25th. Public Health Committee. Electric goods lift, Victoria Square Dwellings, Oldham Road. Form of tender from City Architect, Housing Department, Civic Buildings, 1, Mount Street, Manchester.

August 24th. Tramways Committee. Electrolytic and cadmium copper trolley wire. Specifications from Mr. H. Mattinson, general manager and chief engineer, 55, Piccadilly.

Millom.—August 28th. Urban District Council. H.p. and l.p. mains, h.p. switch cubicle, l.p. switchboard and transformers. (August 13th.)

New Zealand.—CHRISTCHURCH.—October 19th. Christchurch Drainage Board. Three sets of electric centrifugal pumping plant. (A.X. 3215.)*

WELLINGTON.—August 24th. Public Works Department. Synchronous condensers for the Waikaremoana electric power scheme. (B.X. 2608.)*

August 30th. 400-V, 3-phase, slip-ring induction motors and starters.*

September 28th. Three electrically-driven low-lift pumps, with control apparatus, for the Taleri drainage. (A.X. 3274.)*

November 2nd. Electric generators and turbines. (B.X. 2622); indoor control gear and switchgear. (B.X. 2675); 110,000-V transformer for Waikaremoana power scheme. (B.X. 2744.)*

September 7th. Synchronous condenser for the Arapuni electric power scheme. (B.X. 2654.)*

November 23rd. Lightning arresters and transformers. (B.X. 2792.)*

DUNEDIN.—September 8th. City Council. One reaction waterwheel, with governor and valves, &c., one 3,000-kW generator, four 1,000-kW transformers, switchboards, oil-break switches, voltmeters, &c. (B.X. 2676.)*

NEW PLYMOUTH.—October 16th. Harbour Board. One 30-cwt. portal electric jib crane, &c. (A.X. 3458.)*

AUCKLAND.—October 4th. Electric Power Board. Pole oil switches. (B.X. 2795.)*

October 11th. Ironclad switchgear and single-phase transformers. (B.X. 2793.)*

Rochdale.—August 24th. Electric lighting installation throughout St. Peter's Church, Walsden. Vicar.

Rumania.—CONSTANTZA.—September 15th. Port Administration. Supply and erection of 8 electric portable cranes. (A.X. 3399.)*

Sevenoaks.—September 1st. Urban District Council. Supply and installation of an electrically-driven siren at the fire station. (July 30th.)

South Africa.—August 26th. South African Railways and Harbours. Material for the distribution system, Capetown suburban electrification. (B.X. 2680.)*

JOHANNESBURG.—September 18th. Town Council. 6,600-V, truck-type, ironclad switchgear. (B.X. 2767),* underwriters' wire. (B.X. 2766.)*

PRETORIA.—August 26th. Municipal Council. Equipment for five transformer sub-stations.*

Stirling.—August 26th. Town Council. Electrical work in houses and shops. Schedules from Mr. A. H. Goudie, burgh engineer.

Stoke-on-Trent.—September 7th. Electricity Department. One 10,000-kW turbo-alternator and condensing plant. One natural-draught cooling tower. Ironclad l.p., 3-phase switchgear. (July 23rd.)

Tunbridge Wells.—September 11th. Electricity Committee. Two water-tube boilers, superheaters, economisers, mechanical stokers, forced- and induced-draught plant, steel stack, overhead coal bunkers, coal elevator and conveyor, and a truck tippler. (August 13th.)

Warrington.—September 6th. Electricity and Tramways Committee. 12 months' supply of earthenware conduits. (See this issue.)

*Further particulars can be obtained at the Department of Overseas Trade (Inquiry Room), 35, Old Queen Street, S.W.1.

Closed.

Dewsbury.—Town Council. Accepted:—
Cable for the feeder from the electricity works to the Market Place (£816).—W. T. Henley's Telegraph Works Co., Ltd.

Dublin.—City Commissioners. Accepted:—
12 months' supply of electrical wiring accessories.—J. H. Tucker & Co., Ltd.; Roper Bros.; British B.A.G., Ltd.; Drake & Gorham Wholesale, Ltd.; F. W. Parkes & Co.; General Electric Co., Ltd.; "M.K." Electric, Ltd.

Durham.—County Education Committee. Accepted:—
Installation of electric lighting at Deine Lane school (£147).—Devereux, Moodie & Co. At Silksworth school (£179).—Gray Bros. (Newcastle), Ltd.

Glasgow.—By 36 votes to 25, the Corporation, on Thursday last week, accepted the offer of the Whitecross Co., at £1,023, for a supply of trolley wire for the tramways. A subcommittee had recommended acceptance of an offer by Messrs. W. F. Dennis & Co. for German wire, amounting to £980.

Health Committee. Accepted:—
Electric lighting Shettleston Welfare Centre (£146).—Haddow & Co., Ltd.

Hythe.—Town Council. Accepted:—
Sub-main wiring at Council houses (12s. per house).—J. Cain & Co.

India.—The English Electric Co., Ltd., has secured an important new contract from the High Commissioner for the Government of India for electrical equipments for the Great Indian Peninsula Railway (Kalyan extension). This order comprises 15 motor-coach and 42 trailer-coach equipments, and is a repeat of the first one, which included equipments for 38 motor coaches and control equipment for 111 trailer coaches; this was the first railway electrification to be carried out in India. In addition to the new traction equipments, the High Commissioner has placed a further contract with the English Electric Co., Ltd., for twelve 750-V rotary converters to be coupled in series for 1,500 V. Each will be 1,250 kW, or 2,500 kW for each pair. In addition, the company is supplying 22,000-V transformers and automatic d.c. switchgear for three complete units.

In addition to the contract for 41 electric freight locomotives, a further order has been received by Metropolitan-Vickers Electrical Co., Ltd., from the Great Indian Peninsula Railway for an electric passenger locomotive of 2,260 h.p., capable of attaining a safe travelling speed of 85 miles per hour.

London.—H.M. OFFICE OF WORKS.
Supply of "Osram" vacuum and gasfilled lamps for 12 months.—General Electric Co., Ltd.

ADMIRALTY.—
Metal-filament and gasfilled lamps.—Edison Swan Electric Co., Ltd.

Spalding.—Urban Council. Cable in connection with the bulk supply of electricity from Peterborough:—

Pirelli-General Cable Works, Ltd. (Accepted.)	**£20,806**
Johnson & Phillips, Ltd.	21,875
Siemens Bros. & Co., Ltd	21,566
Standard Telephones & Cables, Ltd.	21,550
Callender's Cable & Construction Co., Ltd.	21,145
British Insulated Cables, Ltd.	21,158
Macintosh Cable Co., Ltd.	21,217

Kiosks.—Foster Engineering Co. (£47 10s. each). 14 tenders were received, the highest being £122 each.

Tynemouth.—Electricity Committee. Accepted:—
Cable (£242).—Macintosh Cable Co., Ltd.

Wakefield.—Housing Committee. Accepted:—
Electric wiring at housing estates.—146 houses at Batley Road (£785); White & Co. 450 houses, Snapethorpe (£2,626); and 50 all-electric houses at Snapethorpe (£485).—Horace Smith.

Markets Committee. Accepted:—
Wiring 14 market stalls.—Walter Robb, Ltd.

Warwick.—Board of Guardians. Accepted:—
Installing electric lighting at the Institution (£700).—Midland Electric Light & Power Co., Ltd.

The "Electrical Review" Service Department.

INQUIRIES must be accompanied by a stamped addressed envelope.

We should be glad to learn the names and addresses of makers of the following:—

U-NEK tailors' iron.
RAMIE union midget simplex connector.
SOL electric hair dryer.
CELSIO vacuum cleaners.
Porcelain top lampholders with cord grip and shade carrier.
STONE'S absolute viscometer.

Notes.

Loud-speakers at Brooklands.—On August 7th, the date of the first "Grand Prix" race held in England, Alfred Graham & Company installed public-announcement and band-relaying equipment at the instructions of the Brooklands Automobile Racing Club. Beyond the fact that this was the most important motor racing event ever held in England, the installation in question was also one of the largest ever undertaken; some twenty-six special power "Amplion" loud-speakers were fitted up to cover the numerous enclosures and paddocks, and in various restaurants; the covered stands were likewise not forgotten, so that all those assembled in such places could be informed as to the progress of the race, both in English and French. Interspersed between the announcements a selection of musical items was given. The equipment comprised microphones, microphone amplifiers of

a 4-valve 4-stage type, and final amplifiers of the 6-valve 6-output type, each valve of the final amplifiers supplying one power loud-speaker. The music was provided by means of an "Algraphone" gramophone (another Graham product) and attachment, a device which electrically transmits the impression on the record through the amplifiers.

Educational.—NORTHAMPTON POLYTECHNIC INSTITUTE, SESSION 1926-7.—Engineering College. Day classes commence on Monday, September 27th. An entrance examination in English and mathematics will be held on September 9th and 10th. Evening courses in engineering, fuel technology, and in metallurgy commence on September 20th. Prospectuses can be obtained from the Principal. See our advertisement pages to-day.

Large Remote-Controlled Converter.—According to *Electric Traction*, what is claimed to be the largest automatically controlled converter for railway service was recently put into commission by the New York Rapid Transit Corporation at one of its sub-stations. The machine is a 4,000-kW, 575-V. shunt-wound converter, and is supplied from a 3-phase, 4,200-kVA, 11,000-V transformer at 25 cycles. The h.p. windings of the transformer are connected in star for starting and in delta for full secondary voltage when the running breaker is closed. The machine is started up from an adjacent station, the attendant operating a supervisory relay equipment, which results in the closing of a relay at the machine end to start the converter. The supervisory control regulates other operations, such as shutting down the machine, operating the 13 feeder breakers, and closing or opening any of the six-track breakers. By a unique method of remote metering, the total current furnished by the unit may be read continuously, and by a selective method the current in any one of the individual feeder circuits can also be read. A control line of five wires is used between the dispatcher's office and the station. Four of these are used for the machine control and the fifth for the metering.

Appointments Vacant.—Two assistant telephone engineers for the Oriental Telephone & Electric Co., Ltd. Consumers' engineer and draughtsman in the mains department for the Worthing Corporation Electricity Department. (See our advertisement pages to-day.)

Electricity in Agriculture.—At the Renfrewshire Agricultural Show the Corporation Electricity Department had a tent wherein demonstrations were given to farmers, and officials explained the details of the electrification schemes, emphasising the benefits and low cost of installation and maintenance. The Provost, in an address, drew attention to the great help which electricity offered to farming, and pointed out how farmers in other countries took advantage of electricity.

Great Indian Peninsula Railway.—In addition to the 41 electric freight locomotives which the Metropolitan-Vickers Electrical Co. is building for the above-named railway, we understand it has also an order for a high-speed electric passenger locomotive that will present interesting features. It will be of the 4—6—2 type, and consist of three driving axles, one four-wheel bogie truck, and one two-wheel pony axle working in conjunction with the nearest driving axle, so as to virtually form a four-wheel truck. The locomotives will be mechanically safe up to a speed of 85 miles per hour; for speeds of this magnitude it is necessary that as little dead weight as possible should be carried on the axles, and for this purpose the motors and their gearing will be rigidly mounted on the frame of the locomotive and will transmit their power to the driving axles through a universal motion flexible-link drive which is capable of accommodating the range of movement between axles and frame of the locomotive; all the weight will thus be spring borne, and the centre of gravity will be comparatively high so that the truck will thereby be relieved of shocks. The locomotive will be fitted with six 360-h.p. motors and provided with the Metro-Vick standard electro-pneumatic control. It is the ultimate intention to operate the passenger locomotives in conjunction with some of the freight locomotives mentioned on the very heavy gradient section where the railway crosses the Ghats, where average gradients of 1 in 40 are encountered over long distances. On these gradients a passenger train will be assisted by a freight locomotive operating as a banking engine, and the characteristics of the two locomotives have got to be such that they will operate together with a proper sharing of the load. The weight of the passenger locomotive in working order will be about 92 tons, of which about 58 tons will be adhesive weight, *i.e.*, about 63 per cent. It may be remembered that this new electrification scheme is an extension of the already electrified tracks in Bombay itself, and is to operate on a 1,500-volt overhead wire system.

Electricity on Poultry Farms.—On Thursday last week, Mr. R. Borlase Matthews read a paper before the tenth annual Harper Adams Poultry Conference, entitled "Installing Electricity on Poultry Farms, or the Mechanical Problems involved in the use of Artificial Lighting in Poultry Houses."

Popularising Telephones.—Lieut.-Commander Kenworthy states that he has received permission from Viscount Wolmer to publish a letter on the telephone service which the Assistant Postmaster-General sent him following the recent Parliamentary debate on the Post Office Estimates. The letter is as under:—

"In the course of the discussion on the Post Office Estimates you raised two points to which I am sorry it was not possible to reply in the course of the debate: (1) The education of children in the use of the telephone, and (2) advertising the telephone service. With regard to (1) you may rest assured that the matter is not being overlooked by the Post Office, and anything in this direction which is being attempted in the United States is noted and its suitability to conditions in this country carefully considered. We have just agreed with the Director of Education at Leeds, where the local telephone system is automatic, to install in the Central School of Commerce, in which about 200 day students are trained each year, a pair of telephones with automatic dials for practical demonstrations in the use of the telephone, and we are arranging to give them all the necessary help in making the arrangement a success. It is not, of course, to be expected that all local education authorities, with curricula in most cases already crowded, will be able to allocate time for telephone training, however desirable it may be. Applications from other local authorities for similar facilities will be sympathetically considered in suitable cases. With respect to (2) there has never been a time, since the introduction of the telephone into this country, when there has been so much and so varied telephone publicity work and such a large canvassing staff employed as at present. Wages and commission paid to the canvassing staff during the last financial year amounted to over £135,000, and, as you are probably aware, we are spending at present about £1,000,000 a month upon telephone extensions and development. We most certainly do go out after business, and the rapid growth of the service shows that we are getting it. As a specimen of Post Office telephone publicity literature you may be interested to see the enclosed copy of our latest folder, 'A Telephone For Every Home.' I agree with you, however, that it would pay us to do even more publicity than we are now doing, and the Postmaster-General is giving this matter his very close attention."

An Overhead Fe-line.—A curious accident took place at South Shields on August 12th. In the evening one of the overhead power lines passing down Harton Down Hill suddenly fused and fell to the ground. It appears that a cat climbed the pole and, resting its feet on the bracket, stretched forward and touched the bare 20,000-V cable and so caused a short-circuit. The fault was soon made good.

A Novel Race.—A novel event was witnessed at Brooklands last month. As the result of a friendly wager, Mr. R. M. Hanlon, of Messrs. W. Goodyear & Sons, Ltd., challenged the holder of the world's speed record, Mr. J. G. Parry Thomas, to a contest, Mr. Hanlon agreeing to drive a "Greenbat" electric truck in a handicap competition against Mr. J. G. Parry Thomas in a racing motor car. He drove an ordinary platform electric truck carrying a 2-ton load of wet sand in bags, and it is highly creditable not only to the makers of the vehicle, but also to the driver, that Mr. Hanlon succeeded in winning by two and two-fifths seconds. The truck had a start of 1 hour 22 minutes 38 3/5th seconds, and, according to the *Electric Vehicle*, Mr. Hanlon's time over a course of eight miles showed an average speed of 5¼ miles per hour. Continuing to run, his time over 13 miles 1,055 yd. was 2 hr. 50 min. 28 sec. The truck was a standard all-steel model, entirely British-made at the Leeds factory of Messrs. Greenwood and Batley.

Royal Air Force Commissions.—The Air Ministry announces that further appointments to short-service commissions will be made in September; applications will be welcomed from young men between 18 and 25 years of age who have had some engineering training, or who have shown a bent towards mechanical matters, as well as from those who are keen sportsmen and are desirous of travel and adventure.

Electric Train Accident Inquiry.—An inquiry was held by the Ministry of Transport on August 12th into the collision which occurred between an electric train and a goods train near Newcastle on August 7th. Evidence showed that the "dead man's handle" of the electric train had been tied down with two handkerchiefs, and the train was kept under full power after the driver had met with a fatal accident. The signals were against the train when it ran into the goods train. A report will be issued by the Ministry in due course.

Electric Lighting for Military Vehicles.—The Quarter-Master General, 3, War Office, has recently issued W.D. Specification No. 23, dated March, 1926, for an electric lighting system for mechanical transport vehicles, without self-starters. The specification has been prepared in collaboration with the Accessories and Components Manufacturers' Technical Sub-Committee of the Society of Motor Manufacturers and Traders.

Industrial Research in Australia.—Mr. Gepp, the chairman of the New Migration and Development Board, is to accompany Mr. Bruce, the Prime Minister, to London, to negotiate for co-operation between the Council for Scientific Investigation and Industrial Research there and the similar organisation in Australia.—*Reuters.*

Exhibition of Research Work.—An exhibition of work, showing the latest applications of science to industry, will shortly be opened at the Science Museum, South Kensington. According to the *Morning Post*, the public will be permitted for the first time to see the important work of all the associations engaged in research, such as the National Physical Laboratory, the Fuel Research Board, the Building Research Station, and others, which hitherto has been the exclusive privilege of Fellows and members of the respective Associations and Societies.

Our Personal Column.

(Electrical men are invited to enable us to keep readers of the "Electrical Review" posted concerning their movements.)

The marriage took place on August 3rd, at Carmarthen, of Mr. E. G. MORRIS, assistant engineer at the Carmarthen power station, and Miss MARGARET G. JONES, eldest daughter of Mrs. Jones, of Carmarthen.

Mr. B. BRUNNER, a Dublin telegraph engineer, has secured the position of assistant telegraph engineer on the Central Uruguay Railway of Montevideo. Mr. Brunner has occupied a position for several years past in the Signalling and Telegraph Engineer's office of the Great Southern Railways Co., at Inchicore, Dublin, and on leaving he received a presentation from his colleagues.

A resolution increasing the salary of the electrical engineer at Dumfries from £450 to £500 per annum was approved at the last meeting of the Town Council.

Mr. J. T. GREEN, who recently relinquished his connection with the Liverpool Electric Cable Co., has joined the staff of the Mersey Cable Works, Ltd., Bootle.

To mark the occasion of his leaving the service to become general manager of the Athens Transportation Company, Greece, Mr. H. J. TROUGHTON, mechanical engineer to the Metropolitan Electric Tramways, Ltd., was entertained at a farewell dinner at the Clarendon Hotel, Hammersmith, on July 22nd, and was presented by the tramway staffs with a gold chronometer watch. Mr. C. J. Spencer made the presentation, and congratulated Mr. Troughton on his new appointment. Mr. L. B. HEWITT succeeds Mr. Troughton as mechanical engineer. Mr. Troughton is an A.M.Inst.C.E., A.M.I.E.E., and A.M.I.Mech.E., and has held various appointments in the tramway service for a period of 25 years, including those of technical assistant to the chief engineer of the North Metropolitan Electric Power Supply Company, and later technical assistant to the chief engineer of the Metropolitan Electric Tramways, Ltd.

Mr. GEORGE HASWELL is retiring from the position of rolling-stock superintendent at the Hylton Road Depôt of Sunderland Corporation Tramways. He has held the position since 1903.

Obituary.—MR. F. J. W. LUCK.—Mr. Frederick J. W. Luck, for many years prominent in the engineering counsels of the Westinghouse Electric International Company in various countries, died in London, on July 12th. Mr. Luck's death followed a protracted illness which he contracted while in Brazil, in the electrical development of which he took a large interest. While working as an engineer in Madrid, in 1902, Mr. Luck was engaged by the Société Anonyme Westinghouse as technical adviser to the sales manager for Spain and Portugal. He later was appointed manager for Spain and Portugal, representing the Société Anonyme Westinghouse in both countries. In the autumn of 1905 he was sent by the Westinghouse Electric and Manufacturing Company to Rio de Janeiro, Brazil. He was transferred from Brazil to the London office of the Westinghouse Electric International Company in September, 1923, and retired in July, 1924.

MAJOR J. F. HALL-EDWARDS.—We learn with regret of the death on Sunday, August 15th, of Major Hall-Edwards, at Birmingham, in his 68th year. He was one of the first medical men to take up the study of the Röntgen rays and to use them in surgical practice, and he experimented with them ceaselessly—with disastrous results, for he was eventually attacked by X-ray dermatitis, and after long-continued acute suffering lost his left arm and the fingers of his right hand. Nevertheless, he carried on his work; he was senior medical officer to the X-ray department of the Birmingham General Hospital for 20 years, and rendered valuable service to other institutions of a similar character. Volunteering for the South African War, he was appointed X-ray expert to the Imperial Yeomanry hospitals, and organised an efficient equipment which did excellent work; it was at this time that he began to suffer from the insidious effects of long-continued exposure to X-rays. A Civil List pension was awarded to him in 1908 for his services to the nation. During the Great War he was appointed Major in the Royal Army Medical Corps, and was Principal Medical Officer of the Medical Examiners' Board. In 1922 he received the Carnegie Hero Trust medal.

MR. F. S. TERRY.—The *Electrical World* records the death of Mr. Franklin S. Terry, "a pioneer in the incandescent lamp business and one of the organisers of the National Electric Light Association and the National Electric Lamp Company." He began his active career as a book-keeper with an electric supply company in Ansonia in 1880. He had a genius for incandescent lamp business organisation and amalgamation and was associated with the lamp industry for 35 years. He died suddenly on July 22nd, aged 64 years.

MR. H. SPENCER.—The death took place on August 11th of Mr. Hugh Spencer, electrician, of Keighley, aged 76 years. He had been in business for about 30 years.

MRS. C. FURNESS.—We regret to record that Mrs. Charlotte Furness, wife of Mr. Charles Furness, electrical engineer of Blackpool, died last week. The funeral took place on August 12th, at Singleton. The Blackpool Electricity and Tramway Departments were represented.

Will.—MR. PHILIP LYTTELTON GELL, a director of mining and investment companies, and a trustee of the Victoria Falls and Transvaal Power Co., Ltd., left £38,372.

New Companies Registered.

M. Partridge & Co., Ltd. (215,619).—Private company. Registered August 11th. Capital, £5,000 in £1 shares (2,000 10 per cent. cumulative preference and 3,000 ordinary). Objects: To carry on the business of electricians, mechanical engineers, &c., and to adopt an agreement with Margaret M. Partridge. The first directors are:—Margaret M. Partridge, 16, Southernhay East, Exeter (permanent); Bremer H. Roach, C.A., 4, Copthall Buildings, E.C. Qualification, £50. Remuneration as fixed by the company. Solicitors: Norman, Hart & Mitchell, 21, Panton Street, S.W. Registered office: 4, Copthall Buildings, E.C.

Pasco (Liverpool), Ltd. (215,600).—Private company. Registered August 10th. Capital, £400 in £1 shares. Objects: To carry on the business of wholesale manufacturers, importers and exporters of and dealers in wireless telephones and telephonic and telegraphic apparatus, parts and accessories, &c. The first directors are:—O. Schorah, 2, Brayfield Road, Liverpool; J. Ackers, 181, Bedford Road, Bootle, Lancs.; Mrs. Emily Patterson, 22, Newington, Liverpool; W. Patterson, 22, Newington, Liverpool. Qualification, 1 share. Remuneration as fixed by the company. Solicitor: G. H. Mossop, 61, Lord Street, Liverpool. Registered office: 16, Newington, Liverpool.

Midland Electric Manufacturing Co., Ltd. (215,583).—Public company. Registered August 9th. Capital, £150,000 in £1 shares (75,000 7½ per cent. preference and 75,000 ordinary). The objects are:—To acquire (1) the business of manufacturers of electrical appliances and fittings carried on by the Midland Electric Manufacturing Co., Ltd. (incorporated 1908) at Barford Street and Rea Street, Birmingham; and (2) all the shares in the Birmingham Foundries, Ltd., carrying on business as iron founders at Charles Henry Street, Birmingham, and to adopt an agreement with the Midland Electric Manufacturing Co., Ltd., A. A. Miller, the liquidator thereof, and W. L. Barber; to carry on the business of mechanical and electrical engineers, electricians, pottery and electrical porcelain and electrical insulation manufacturers, iron and brass founders, &c. The first directors are:—W. L. Barber, Woodland Court, Wellington Road, Edgbaston, Birmingham, manufacturer; B. D. F. Docker, J.P., The Gables, Kenilworth (director of Metropolitan Carriage, Wagon and Finance Co., Ltd.); C. H. Smith, Phœnix Chambers, Colmore Row, Birmingham, C.A. The said W. L. Barber and B. D. F. Docker shall, so long as they each hold 30,000 shares, be entitled to remain directors. Qualification of directors: 500 shares. Remuneration of directors (other than salaried directors), £100 per annum (chairman, £250). Solicitors: Evershed and Tomkinson, 25, Temple Row, Birmingham. Registered office: M.E.M. Works, Barford Street, Birmingham.

M. C. L. and Repetition, Ltd. (215,618).—Private company. Registered August 11th. Capital, £120,000 in £1 shares. The objects are:—To carry on the business of electrical engineers and contractors, manufacturers of and dealers in dynamos, lighting equipments, accumulators and electrical apparatus for lighting, starting and ignition equipments for motor cars, motor cycles, motor boats and aircraft of all kinds and other motor accessories and automatic screw machine products and the like. The subscribers (each signing for one share) are:—S. H. Thomas, 18, Austin Friars, E.C.2, solicitor; and A. C. Dowsing, 4, Larden Road, Acton, W.3, accountant. The first directors are to be appointed by the subscribers. Any holder or holders on joint account of at least £20,000 of the original nominal share capital shall be entitled to be represented on the board at all times by one person in respect of every complete £20,000 shares held by them. Remuneration as fixed by the company. Solicitors: Slaughter & May, 18, Austin Friars, E.C.2.

Kamm & Co., Ltd. (215,580).—Private company. Registered August 9th. Capital, £10,000 in £1 shares. Objects: To acquire the business of an electrical and scientific engineer, manufacturer of kinematograph apparatus, appliances and instruments, paint projectors, oxygen generators and electrical and scientific instruments now carried on by L. U. Kamm at 27, Powell Street, Goswell Road, E.C., and 121, Shaftesbury Avenue, W., as "L. Kamm." The permanent directors are:—L. U. Kamm, 88, Hornsey Lane, Highgate, N.; Mrs. Maria Kamm, 88, Hornsey Lane, Highgate, N. Solicitors: Lempriere & Hunter, 52, Lincoln's Inn Fields, W.C. Registered office: 27, Powell Street, Goswell Road, E.C.

Alexander & Mann (Harrow), Ltd. (215,547).—Private company. Registered August 7th. Capital, £250 in 5s. shares. Objects: To manufacture, put up and use telephones, telegraphs (wireless or other), phonographs, dynamos, accumulators, lamps and electrical apparatus (including cables and wires), to carry on business as photographers and manufacturers of and dealers in photographic, kinematographic and other lamps, apparatus and appliances, manufacturers of and dealers in pianos and organs, manufacturers of and dealers in apparatus, appliances and attire for use in any kind of athletic sport, &c. The first directors are:—P. Alexander, 11, Monivea Road, Beckenham; S. L. Mann, 391, Strand, W.C.2. Remuneration of first directors as fixed by agreement; of others as fixed by the company. Solicitors: Stanley Robinson & Commin, 53, Shorts Gardens, W.C.2. Registered office: 150, Pinner Road, Harrow, Middlesex.

Official Returns of Electrical Companies.

Nelson Electric Co., Ltd.—Debenture dated July 16th, 1926, to secure £3,600 charged on the company's undertaking and property, present and future, including uncalled capital. Holders: Anglo Oriental and General Investment Trust, Ltd., 31-33, Bishopsgate, E.C.2.

Mechanical Ads, Ltd.—A. C. Vincent, of 13, Queen Street, Cheapside, E.C., ceased to act as receiver on July 22nd, 1924.

Cleveland Metal Co., Ltd.—C. U. Peat, of Royal Exchange, Middlesbrough, was appointed receiver and manager on July 31st, 1926, under powers contained in debentures dated April 19th, 1921.

County of London Electric Supply Co., Ltd. (34,320).—Capital, £7,000,000 in 3,500,000 6 per cent. preference and 3,500,000 ordinary shares of £1 each. Return dated April 6th, 1926. 3,225,000 preference and 1,330,000 ordinary shares taken up. £4,449,220 paid on 3,225,000 preference and 1,224,220 ordinary. £105,780 considered as paid on 105,780 ordinary. Mortgages and charges, £1,500,000.

Premier Accumulator (1921), Ltd. (178,158).—Capital, £40,000 in £1 shares. Return dated June 1st, 1926. All shares taken up. £18,749 paid, being £1 per share on 11,249 and 15s. per share on 10,000 shares. £18,751 considered as paid on 18,751 shares. Mortgages and charges, nil.

Pritchett & Gold & E.P.S. Co., Ltd. (166,503).—Capital, £200,000 in 100,000 preference and 100,000 ordinary shares of £1 each. Return dated April 15th, 1926. All shares taken up. £30,394 paid on 15,233 preference and 15,161 ordinary. £169,606 considered as paid on 84,767 preference and 84,839 ordinary. Mortgages and charges, nil.

Newcastle-upon-Tyne Electric Supply Co., Ltd. (27,997).—Capital, £6,500,000 in 1,500,000 7 per cent. cumulative preference, 2,500,000 5 per cent. preference, and 2,500,000 ordinary shares of £1 each. Return dated April 6th, 1926. 1,500,000 7 per cent. cumulative preference, 1,532,017 5 per cent. preference, and 2,312,681 ordinary shares taken up. £4,351,645 paid on 1,500,000 7 per cent. cumulative preference, 725,905 5 per cent. preference, and 2,162,645 ordinary, leaving £36,904 in arrears. £956,148 considered as paid on 806,112 5 per cent. preference, and 150,036 ordinary. Mortgages and charges, £3,811,658.

D.P. Battery Co., Ltd. (44,084).—Capital, £100,000 in £1 shares. Return dated July 9th, 1926. All shares taken up. £28,000 paid. £72,000 considered as paid. Mortgages and charges, nil.

Europe and Azores Telegraph Co., Ltd. (39,452).—Capital, £200,000 in £10 shares. Return dated June 23rd, 1926. All shares taken up. £144,320 paid. £55,680 considered as paid. Mortgages and charges, nil.

Teignmouth Electric Lighting Co., Ltd. (179,116).—Capital, £30,000 in £1 shares (12,500 ordinary and 7,500 preference). Return dated June 15th, 1926. 1,982 preference and 7,560 ordinary shares taken up. £9,042 paid. £500 considered as paid. Mortgages and charges, £17,199.

W. H. A. Robertson & Co., Ltd. (95,906).—Capital, £36,000 in 600 ordinary and 3,600 preference shares of £10 each. Return dated August 2nd, 1926. 600 ordinary and 2,180 preference shares taken up. £25,650 paid, being £5 per share on 430 preference, £10 on 1,750 preference, and £10 on 600 ordinary. Mortgages and charges, nil.

Delhi Electric Tramways and Lighting Co., Ltd. (88,758).—Capital, £170,000 in 140,000 preferred and participating and 30,000 ordinary shares of £1 each. Return dated June 30th, 1926. 100,000 preferred and participating and 20,000 ordinary shares taken up. £100,000 paid on the preferred and participating. £20,000 considered as paid on the ordinary. Mortgages and charges, £35,800.

United Electric Tramways of Monte Video, Ltd. (80,456).—Capital, £1,000,000 in 100,000 preference and 100,000 ordinary shares of £5 each. Return dated July 9th, 1926. All shares taken up. £295,105 paid on 26,221 preference and 32,800 ordinary. £704,895 considered as paid on 73,779 preference and 67,200 ordinary. Mortgages and charges, £892,367.

Ilfracombe Electric Light and Power Co., Ltd. (71,378).—Capital, £15,000 in £5 shares. Return dated May 24th, 1926. All shares taken up. £15,000 paid. Mortgages and charges, £10,000.

George Moritz, Ltd. (38,158).—Capital, £10,000 in £1 shares. Return dated April 14th, 1926. 9,061 shares taken up. £9 paid. £9,072 considered as paid. Mortgages and charges, nil.

Middlesbrough Steel Tube & Conduit Co., Ltd.—J. H. Anderson, C.A., of Middlesbrough, was appointed receiver on July 31st, 1926, under powers contained in trust deed dated October 17th, 1925.

"M.K." Electric, Ltd.—Issue on August 2nd, 1926, of £1,000 debentures, part of a series already registered.

Llandudno and Colwyn Bay Electric Railway, Ltd.—Trust deed dated July 30th, 1926, to secure £100,000 prior lien debenture stock, and premium of 5 per cent. Property charged: The railway undertaking and all permanent ways, sidings, stations, car-sheds, and depôts, cars and other rolling stock, cables, wires, electrical and other plant and machinery, and the company's other assets, present and future (all in priority to the trust deeds securing the first mortgage debenture stock). Holders:—Trust Union, Ltd., 157, Winchester House, Old Broad Street, E.C.

City Notes.

Reports and Meetings of Electrical Companies, Dividend Results, &c.

Tyneside Tramways and Tramroads Co.

The directors report that for the half-year ended June 30th, 1926, the surplus of receipts over expenses was £1,784 plus £991 brought forward from last half-year. After deducting interest on mortgages, loan, &c., amounting to £1,861, £914 remains to be carried forward. The directors are unable to recommend the payment of any dividend for the half-year. The traffic receipts show a decrease of £3,366, as compared with the corresponding half of 1925. This is due to the continued depressed state of industry in the district, accentuated by the nine days' stoppage caused by the general strike and also the dispute in the mining industry. At the half-yearly meeting, on August 10th, Mr. G. E. Henderson, who presided, said that the absence of any return on the capital invested was due to the causes over which the directors had no control. The chief cause was the grave depression of trade in the Tyneside area. There had been a decline in yearly traffic of over two million passengers as compared with 1921, or nearly 25 per cent. of the passengers annually carried. Other causes were the heavy burden imposed on all tramway companies by road maintenance, which had been greatly increased by the heavy motor traffic, including passenger 'buses running in competition with tramways, the proportionately higher rate of wages now paid, and the increasing competition of motor-'buses. They had, however, been able to reduce operating expenses by £3,138, and the mileage run had decreased by 35,712, but of that 13,657 miles was due to the general strike stoppage. If any improvement in trade were long postponed the position of the company would become increasingly difficult. Mr. Summers Hunter said there had been definite signs of improvement on the eve of the general strike, but this was wilfully strangled by the Labour leaders, who openly professed themselves revolutionaries. "In engineering works and shipyards 60 per cent. of the men are unemployed. Many of the shipyards, I believe, will never open again, and there are 18 to 20 closed at present," he said. "The welfare of the Tyneside Tramways, which follow the contours of the river, depends on the welfare of industry."

Brazilian Traction, Light and Power Co.

The *Financial Times* states that at the annual general meeting of the Brazilian Traction, Light, Heat and Power Co., held lately at Toronto, Mr. E. R. Wood, the vice-president, said that the new contract with the State of Sao Paulo was very advantageous to the company. He regarded this as preliminary to the arrangement of better rates in Rio de Janeiro. Mr. Wood commented upon the measures taken to meet the 'bus competition in the cities of Rio de Janeiro and Sao Paulo. He stated that the service now in operation, consisting of 34 'buses, would be extended as circumstances warranted. He further announced that the power situation in both States was all that could be desired. The first set of the company's extension of plant would be in operation shortly, and the second set about six months thence. There were adequate facilities for the production of sufficient power to meet both current and prospective requirements for a long time to come. Additional sets were being added in both cases. Mr. Wood drew optimistic conclusions regarding the company's future prospects. Reports to the effect that the company is contemplating some kind of capital reorganisation have been officially denied.

Havana Electric Railway Co.

Cabled advices from New York state that the incorporation of a new company called the Havana Electric Railway Co., under the laws of the State of Maine, will be made soon, and it is stated this step is taken preliminary to carrying into effect the programme of the Havana Electric Railway, Light and Power Co., to segregate its street railways now owned by the Havana Electric Railway, Light and Power Co., the Camaguay Electric Co., and the Santiago Electric Light and Traction Co. The lines of the Havana Electric Railway in 1925 carried approximately 136,000,000 passengers, and the gross revenues were over $6,960,000, and the net earnings, after allowing for operating expenses, maintenance and taxes, amounted to $1,880,000.—*Financial News.*

An issue of $5,500,000 25-year, 5½ per cent. gold debentures was made in New York during the current week.

German Companies.

The *Rhenish Electricity Company*, of Mannheim, proposes to pay a dividend at the rate of 8 per cent. out of net profits of 1,174,000 marks for 1925, as compared with 7 per cent. and 1,020,000 marks respectively in 1924.

The *Telephone Works Company* (late Berliner), of Hanover, is reported to have acquired all the shares in the Dr. Huth Wireless Telegraph Company, of Berlin.

The *Isola Works Company*, of Duren, reports a slight loss for 1925-26, although a satisfactory improvement has taken place since the end of March, particularly in the export trade. Not being in agreement with the price policy of the insulated-conductor syndicate, of Berlin, the company has not joined that combination.

French Companies.

The *Compagnie d'Electro-Entreprise* reports a loss of 97,000 fr. for 1925, as compared with profits of 925,000 and a dividend at the rate of 7 per cent. in 1924.

The *Compagnie Générale d'Entreprises Electriques* reports net profits and balance forward amounting to 1,676,000 fr. for 1925, the distribution being at the rate of 60 fr. per share.

Italian Company.—The *Società Ercole Marelli*, of Milan, maker of the Marelli magnetos, reports a net profit of 1,950,175 lire for the last financial year, out of which a dividend of 6 per cent. is being declared.

English Electric Co. of Canada, Ltd.—After providing for depreciation, the accounts for the past year show a net profit of $21,004, as compared with $55,092 in 1924. A dividend of 2½ per cent. has been paid on the cumulative preferred stock, and the balance has been added to the accumulated surplus, making $293,848.

Stock Exchange Notices.—The undermentioned securities have been ordered to be officially quoted:—

Isle of Thanet Electric Supply Co., Ltd.—72,000 six per cent. cumulative preference shares of £1 each, fully paid, Nos. 210,001 to 282,000.

Telephone Manufacturing Co., Ltd.—410,000 ordinary shares of 10s. each, fully paid, Nos. 1 to 410,000.

Venezuela Telephone and Electrical Appliances Co.—The directors have received an offer for the undertaking, and shareholders will be informed and a meeting called as soon as terms have been provisionally arranged.

Clyde Valley Electrical Power Co.—The directors have decided to pay a half-yearly dividend of 3 per cent. actual, less tax, on the ordinary shares.

Torquay Tramways Co., Ltd.—An interim dividend of 4 per cent., free of tax, has been declared on the ordinary shares, as in 1925.

Clontarf and Hill of Howth Electric Tramroad Co.—An interim dividend of 3 per cent. has been declared.

Dublin United Tramways Co., Ltd.—The ordinary shares are to receive an interim dividend of 4 per cent., as in 1925.

Stocks and Shares.

MONDAY EVENING.

BRAZILIAN Tractions have held the board as being one of the principal features of interest in Stock Exchange markets during the past week. The price of 115 x.d. shows no net movement, but the price has been run up and down in lively fashion. There is a very unusual amount of speculation going on in the shares, the area of active interest widening to include several of the Belgian cities, whence orders have been coming in considerable volume. The directors of the company have issued a statement to the effect that no capital reorganisation of any kind has been, or is, under consideration. This is in reply to the various rumours current for some time

past as to the likelihood of the company splitting its shares. In the preferred shares, investment buying has lifted the price to 107½.

Side by side with the rise in Brazilian Tractions, Sidros have been going ahead, and the price of these, which was 8¼ a couple of weeks ago, is now about £3 higher. The buying in their case has also proceeded largely from the Continent, where, too, some of the holders have been exchanging their Sidros for speculative investment in Mexico Tramways shares, the market in which has developed noticeable activity, with a rise in the price to 16½. The company's prior-charge bonds are almost unchanged. Speculators in the shares are talking of a possible rise of several points, and the theory of the purchasers seems to be that the price is likely to follow that of the shares of the Sidro company, which controls the Mexican Light and Power, the latter, in its turn, holding the principal interest in Mexico Tramways. Rio Tramways Fives are better at 88, Montreal Light and Power at 235 is three points higher on the week.

In the British group no changes have occurred. British Electric Traction stocks maintain their prices; London and Suburban preference continue dull. The London General Omnibus Company has placed on the market during the past few business days half-a-million pounds 5 per cent. income debenture stock. The starting price was 84¼. A few hours sufficed for the bulk of the new issue to be absorbed, and the quotation hardened to 85. Resolutions to sanction the reorganisation scheme of the Underground Electric Railways of London were duly passed at a meeting last week. The ordinary shares strengthened thereupon to 3¾, and the 1s. shares are a little better at 11s. Home Railway stocks as a whole show recovery from their recent acute depression.

The Stock Exchange view is that the coal crisis is within sight of its conclusion, and, upon the strength of this hopefulness, a good many prices are better. One of the marks of this better feeling is a widely-spread improvement in shares of the iron and steel companies, assisted by the fact that some of the companies are getting good contracts, both Vickers and Armstrongs having been particularly favoured in this way. The English Electric Company announces that it has secured an important new contract from India for electrical equipment of the Great Indian Peninsula Railway. The price of the shares has strengthened to 15s., and the 6 per cent. preference remain at 18s. It may be recalled that the company passed its dividends for last year, though the report recorded that the company had unexecuted orders in hand which exceeded the whole output for 1925.

In the electricity supply market, a few dividend deductions took place last Thursday, the Stock Exchange account day, and, allowing for these, the tendency of prices is steady. Yorkshire Electrics are a little better at 27s. x.d. City of London eased off to 47s. 3d. Metropolitans have recovered their dividend at 37s. The Clyde Valley Electrical Power Company announces an interim dividend of 3 per cent., payable on September 16th. This is the same rate as was paid in each of the three preceding years. The price of the shares is 27s., at which, on the basis of the 8 per cent. dividend for the full year, the yield on the money comes to £5 18s. 6d. per cent. Whitehall Electric debenture is better at 101.

Marconis are unchanged at 15s. Marconi Marines strengthened to 20s. In Canadian Marconis there is a slight revival of speculation, the present price of 3s. 9d. being held to show promise of improvement in view of the early opening of the Bodmin station that will make another link in the wireless chain. The station should have been finished earlier, but, owing to the coal crisis, this part of the programme could not be completed to date. The company issued new shares at 4s. not long ago. No doubt the fact of the price being comparatively low, permitting of a speculator to acquire a fair number of shares for a modest amount of money, contributes to the favour with which Canadian Marconis are regarded at the moment. The Radio Corporation, in its statement of operations for the quarter ended June 30th last, shows surplus profits of $82,000. The surplus profits for the six months which ended with the same quarter were $1,870,000.

British Aluminium ordinary are 1s. higher at 46s. 9d. Brush gained 9d., rising to 25s. 9d. General Electric ordinary at 29s. 3d. and the preference at 22s. 6d. are 6d. up and down, respectively. Siemens recovered to 30s. A 5s. fall in Telegraph Constructions reduced the price to 28½. There are a few Great Northern Telegraphs offering at 27¼. The company reduced its dividend for 1925 to 20 per cent., after paying 22 per cent., or more, in each of the previous 11 years. This caused a decline to the present price, at which the yield on the money comes to 7¼ per cent. The company's balance sheet is remarkably strong, showing assets, outside the business altogether, equivalent to £27 per share—not far short of the market value of the shares. The chairman spoke cautiously at the last meeting, and his remarks appear to have been taken very seriously by the more nervous proprietors.

Cable stocks and shares are uninteresting. Automatic Telephones lost 1/16th at 2 7/16th. Telephone Construction new shares keep in the neighbourhood of 1s. discount. The Rubber market holds its lately-acquired firmness, but there is no business worthy of mention in the shares. Perak Hydraulic new debenture scrip is being absorbed by the speculative investor at 4 discount. A new company is the Midland Electric Manufacturing Co., Ltd., recently registered with a nominal capital of £150,000 in shares, ordinary and preference, of £1 each. The company will take over the business at present existent under the same title, and will acquire all the shares in Birmingham Foundries, Ltd.

Share List of Electrical Companies.

	Nom. £	Dividend. 1924	Dividend. 1925	Price Aug. 16 1926.	Rise or fall.	Yield p.c.
HOME ELECTRICITY COMPANIES.						
Bournemouth and Poole	1	14	14	54/6xd	-1/6	5 3 9
Brompton Ordinary	1	10	10	32/3	—	*6 4 0
Charing Cross Ordinary	1	15	15	44/6xd	—	6 14 10
do. do. 4½ Pref.	1	4½	4½	17/6	—	5 2 10
Chelsea	1	12	12	2	—	6 0 0
City of London	1	15	15	47/3	-1/-	6 7 0
do. do. 6% Pref.	1	6	6	22/6	—	5 6 8
Clyde Valley	1	8	8	27/-	—	5 18 6
County of London	1	15	15	59/6	—	5 0 10
do. do. 6 % Pref.	1	6	6	22/6	—	5 6 8
Edmundson's Ordinary	1	7	8	24/3	—	6 12 0
do. 7% Pref.	1	6	7	22/6	—	6 4 5
Elec. Supply Corporation	1	10	10	31/3	—	6 8 0
Kensington Ordinary	5	15	15	13½xd	—	5 11 1
Lancs. Light and Power	1	7½	7½	24/-	—	6 5 0
London Electric	1	10	10	32/6	—	6 3 1
do. do. 6% Pref.	5	6	6	6⅞	—	5 10 8
Metropolitan	1	11	11	37/-xd	—	5 18 11
do. 4½% Pref.	1	4½	4½	17/6	—	5 2 10
Midland Counties	1	5½	6	20/6	—	5 17 1
Newcastle-on-Tyne Ordinary	1	7	7	21/3	—	6 11 9
do. 5% Pref.	1	5	5	18/9	—	5 6 8
do. 7% Pref.	1	7	7	24/-	—	5 16 8
Notting Hill 6% Pref.	10	6	6	10	—	6 0 0
North Met. Elec. 6% Pref....	1	6	6	22/6	—	5 6 8
St. James' and Pall Mall	5	17½	17½	16¼	—	5 8 6
South London...	1	15	15	2⅝	—	5 14 8
South Metropolitan Pref.	1	7	7	26/3	—	5 6 8
Urban Ordinary	1	4	7	1⅛	—	6 4 5
do. 6% Pref.	1	6	6	20/6	—	5 17 1
Westminster Ordinary	1	15	15	42.6xd	—	7 1 2
Whitehall Elec. Invst. 7½% Pref....	1	7½	7½	20/3	—	7 8 0
Yorkshire Elec.	1	8	8	27/-xd	+6d.	5 18 6
HOME RAILS.						
Central London Ord. Assented	Stock	4	4	70	—	5 14 4
Metropolitan	,,	5	5	63	-¼	7 18 8
do. District	,,	5½	5½	51½	+½	6 15 11
Underground Electric Ordinary	10	Nil	Nil	2⅝	+⅛	Nil
do. do. "A"	1/-	Nil	Nil	11/-	+6d.	Nil
do. do. Income	Bonds	6	6	103	—	*5 16 6
TELEGRAPHS AND TELEPHONES.						
Anglo-Am. Tel. Pref.	Stock	6	6	104½	—	5 14 10
do. Def.	,,	1½	1½	24¾	—	6 1 3
Automatic Telephone	1	3	6	2⅞	-1/16	4 2 1
Chili Telephone	5	5	6	7⅛	—	*4 4 11
Cuba Sub. Ord.	10	5	5	6¾	—	7 5 6
Eastern Extension	10	10	10	15½	—	*5 4 8
Eastern Tel. Ord.	Stock	10	10	189½	—	*5 5 6
Globe Tel. and T. Ord.	10	10	10	19½	—	*5 4 8
do. do. Pref.	10	6	6	11	—	5 9 1
Great Northern Tel.	10	22	20	27½	—	7 5 6
Indo-European	25	8½	10	46½	—	*5 7 6
Marconi...	1	10	Nil	15/-	—	... ...
Marconi Marine	1	10	7½	20/-	+1/16	7 10 0
Oriental Telephone Ord.	1	12	12	45/6	—	*5 5 6
United R. Plate Tel....	5	8	8	8⅝	—	*4 17 9
Western Telegraph	10	10	10	18¾	—	*5 7 8
HOME AND FOREIGN TRAMS, &c.						
Anglo-Arg. Trams First Pref.	5	5½	5½	8	—	9 8 4
do. do. 2nd Pref.	5	6	6	2½	—	11 3 3
do. do. 5% Deb.	Stock	5	5	73½	—	6 16 1
British Electric Traction Ord.	,,	7	8	134½	—	5 18 11
do. do. 6% Pref.	,,	6	6	110	—	5 9 1
Brazil Traction	100	4	5	115xd	-1½	4 7 0
Brit. Columbia Elec. Rly. Pcc.	Stock	5	5	86½	—	5 15 7
do. do. Preferred	,,	96/-	126/9	109½	—	*5 15 9
do. do. Deferred	,,	122/5	8	126	—	*5 17 8
do. do. Deb.	,,	4¼	4¼	79	—	5 7 7
London & Sub. Trac. 5% Pref.	1	2½	Nil	5/-	—	Nil
London United Tram. Deb.	Stock	4	4	47	—	8 10 2
Mexico Trams 5% Bonds	—	5	5	71½	—	6 19 10
Mexican Light Common	100	Nil	Nil	31½	—	Nil
do. Pref.	100	Nil	Nil	80½	—	Nil
do. 1st Bonds	—	5	5	68½	—	5 7 6
Yorkshire (West Riding)	1	5	—	11/6	—	... ...
MANUFACTURING COMPANIES.						
Babcock & Wilcox	1	12	18	50/-	—	*5 4 0
British Aluminium Ord.	1	5	10	46/9	+1/-	4 3 9
British Elec. Transformer Pref.	1	Nil	7	18/9	—	7 9 4
British Insulated Ord.	1	15	15	3⅜	—	4 8 11
Brush Ord.	1	10	10	25/9	+9d.	7 15 4
Callenders	1	15	15	3⅛	—	4 12 4
do. 6½% Pref....	1	6½	6½	23/9	—	5 9 5
Crompton Ord.	1	Nil	Nil	13/3	—	... ...
Edison-Swan	4/-	10	10	11/-	—	3 12 9
do. 5% Deb.	Stock	5	5	86	—	5 16 3
Electric Construction	1	10	10	32/-	—	6 0 0
Enfield Cable, Pref.	1	7½	7½	1¼	—	6 6 4
English Electric	1	5	Nil	15/-	+1/16	... ...
do. do. Pref.	1	6	6	18/-	—	6 13 4
Gen. Elec. Pref.	1	6½	6½	22/6	-6d.	5 15 7
,, Ord.	1	5	7½	23/3	+6d.	5 2 7
Henley	1	16	20	8¼	—	5 3 3
do. 4½% Pref.	5	4½	4½	4¼	—	5 6 0
India-Rubber...	1	5	5	23/-	—	*4 6 11
Johnson & Phillips	1	10	17½	63/-	—	5 11 1
Met.-Vickers Ord.	1	8	8	24/6	—	6 12 0
do. Pref.	2	8	8	2¾	—	6 14 9
Siemens Ord.	1	7½	7½	30/-	—	5 0 0
Telegraph Construction	12	20	10	28½	-½	*4 3 6

*Dividends paid free of Income Tax.

The British Association.—II.

The Oxford Meeting.

Although there was something of an exodus from Oxford over the week-end, a large number of those who came down on Wednesday remained and took the opportunity to inspect the colleges and make various excursions. Among the addresses on Sunday, August 8th, was one by Sir Oliver Lodge, who almost invariably occupies this role, and those who took advantage of the opportunity were afforded another intellectual treat. Almost inevitably, Sir Oliver made the constitution of matter part of his text, and in partially answering the question: "What is matter?" by saying that it is composed of electricity, he was able to go a step further and put the question: "What is electricity?" with some hope of giving an answer of a sort even to this conundrum. Electricity, he said, was made up of small particles called electrons and protons, an answer which could not have been given 50 years ago, but, as Sir Oliver reminded his audience, they did not know what these were. From that he proceeded to ask: "What is ether?" and added that he felt in his bones, that electricity was a modification of ether. The net result, however, inevitably was that they were still wondering where they were, whither they were going, and whence they came—but, as all those who have studied Sir Oliver Lodge's views on this matter will appreciate, it is his opinion that the next great advance in knowledge will be to bring the spiritual conception of the universe out of the domain of religion into that of actual scientific discovery.

Monday morning, August 9th, saw a resumption of work in all the Sections, but there was little of electrical interest. Section G was mainly occupied with aircraft and high-duty compression ignition engines, but the final paper was of electrotechnical interest in that it related to the protection of aluminium and its alloys against corrosion by anodic oxidisation. The work by Dr. Bengough and Mr. Sutton upon which the paper was based, appears to be of fundamental importance, and the authors of the process described are almost embarrassed by the number of applications made to them by aircraft manufacturers to treat their material by their process.

As usual, Tuesday (August 10th) saw the close of the proceedings of most of the Sections, but one or two still had sufficient to justify a session on Wednesday morning. On Tuesday Section G dealt with several papers not related to the electrical industry, but the final paper, by Mr. Edward Hughes, on "The Influence of Voltage Harmonic on Power Factor Correction," comes well within our interest, and will be reported later.

Section A (Mathematical and Physical Science) had another of its now notoriously crowded attendances to hear a series of papers on various subjects. Special attention may be directed to two papers by Prof. W. Wien, of Munich, dealing with the direction of electrons, emitted by the photo-electric and Compton effect, in the one case, and spectral lines in the electric field in the other, whilst a contribution by Prof. Vessot King, on "The Gyro-magnetic Electron," has already been abstracted in our columns.

There was a certain liveliness in Section F (Economics) concerning a paper dealing with the first year of the gold standard, and it was not surprising, considering how the theoretical issues involved in the return to gold must of necessity be controversial. Some of the economic experts present would, could they have had their way, have returned to the gold standard in 1922 or 1923 instead of 1925. In the same Section there were all the elements of a lively discussion on the proposal of Dr. Bowie for co-partnership in the coal industry, but the chairman, utterly callous, decided soon after one o'clock that the material wants of the human body—at any rate his own—demanded satisfying, and he closed the meeting so abruptly that one gentleman was left on his feet just beginning to speak. However, the discussion went on long enough for a representative of the National Union of Railwaymen to state that the trade unions did not dislike co-partnership *per se*, but would welcome it if it involved giving Labour a share in the management of the business.

The Psychological Section (J) having exhausted its purely industrial subjects on Friday, got back in the same direction again on Tuesday in an illustrated lecture on recent progress in vocational selection, in which it was stated that the older methods of vocational selection had been all wrong and that modern methods employing mental and physical tests were now the thing.

The only other item to be mentioned is a statement by Dr. H. M. Vernon regarding an endeavour by him and a colleague to improve the efficiency of the miner's electric lamp by a modification of the reflecting arrangements, an improvement of 44 per cent. being mentioned, and a 50 per cent. improvement may be possible.

Only a few Sections were left with programmes on Wednesday, August 11th; Section G (Engineering) had quite a full one, although it had to be rushed through on account of the necessity for the officers to attend the final meeting of the whole Association, at which Sir Oliver Lodge presided. At this meeting, a letter was read from H.R.H. the Prince of Wales, in which he regretted his inability to return to Oxford after the first few days of the meeting, and expressed his belief, from what he had seen during his stay in Oxford, that there was alive in the army of scientific workers to-day a spirit of enthusiasm and energy which could not fail to achieve great things. This message was suitably acknowledged, and the General Meeting also paid generous tribute to the hospitality which had been extended to the Association both by the scientific men and institutions of Oxford and by the Corporation.

Prior to this General Meeting, the sectional programmes had been worked off, and more "life" was crowded into the short space during which Prof. G. W. O. Howe read his paper, and the discussion upon it, in Section G than had manifested itself during the whole of the remainder of the proceedings during the gave the B.E.S.A. over electrical definitions. We shall give the details in due course, but it may be mentioned that two of the B.E.S.A. staff were specially recalled from holidays to Oxford when it was l nown that Prof. Howe was giving this paper (it was not in the original programme) in order to put up a defence.

The rest of the meeting was something of a scramble so far as the authors were concerned, and no time was allowed for discussion. The two papers of interest were the "Distribution of Pressure in Impulse Steam Turbines at Varying Loads," by W. J. Kearton, and "The Classification of Patent Specifications," by Dr. A. P. Thurston.

Meantime, in Section F (Economics), Mr. A. W. Flux, of the Board of Trade, had been discussing export industries, and examined the changes in the oversea markets for the products of our leading export industries, more particularly with a view to measuring the changes in the character of the products taken by individual markets or by oversea markets as a whole. It is interesting to note that the exports of electrical machinery in 1925 represented a tonnage increase of more than 23 per cent. compared with 1913, whilst the value per ton was about double that of the pre-war year.

There is nothing more which calls for record in these notes so far as the Sections are concerned, and it only remains to be said that the meeting next year will be at Leeds, and in 1928 at Glasgow, whilst there seems every prospect that South Africa will be visited in 1929. The attendance at Oxford was 3,717, as compared with the previous best, at Manchester some years ago, of a little over 3,800.

Some Features of the Economics of Electrical Distribution.

By J. M. Kennedy, M.Inst.C.E., M.I.E.E.

(Abstract of a paper read before Section G.—Engineering.)

The introduction of the steam turbine and the unsuitability of d.c. generators for a turbine drive, have led to the almost universal adoption of a.c. for generation in stations of any size, and now approximately 90 per cent. of the electricity generated in this country is in the form of 3-phase a.c. at about 6,000 or 11,000 V, and such supplies are, in a great measure, converted into d.c. For any new distributing system it is much more economical to distribute low-pressure a.c. rather than d.c. The expense of changing over an existing d.c. system is often prohibitive and converting plant is used. In some districts the d.c. system is being supplemented by an a.c. system, especially in congested areas. The technical staff employed by many undertakings has hitherto been far more busy with the production of electricity rather than with its distribution and sale. For these reasons the published data referring to electricity supply are nearly always confined to the costs of generation and do not give a detailed analysis of the distribution side If the proposals now before Parliament materialise, the majority of the existing undertakings will be able to purchase electricity in bulk, and they will thus become distributing authorities only. The object of this paper is to consider some of the problems with which we are faced under this new set of conditions.

The total invested in electricity supply undertakings in Great Britain at the end of 1924-25 amounted to £194,000,000, of which £106,000,000, or 54.6 per cent., has been invested in the distribution side of the system. From the capital point of view, therefore, the distribution side is more important than the generating side. With co-ordinated generation in the future, it seems probable that the capital spent on distribution will amount to a still greater percentage of the whole than it does at the present time. A consideration of the total revenue in each of the last four years anu the revenue per £100 of capital invested in the distribution side of the business shows that the increase in revenue is not so rapid as the increase in capital invested. This in itself is not a bad sign, so long as it is accounted for by a reduction in the cost of production and/or distribution; but if it indicates a falling-off in the number of kWh sold per £1 of capital invested, it is a matter which requires investigation. Studying the total number of kWh sold in each of the last four years, the number of kWh sold per £1 of capital invested in the distribution business, and conversely the amount of distribution capital per 1,000 kWh sold, it will be seen that there has been an actual increase in the number of kWh sold per £1 of capital, but that there is a decline in the rate of increase in the last few years, and it looks as if the sales might become steady at a figure of about 48 kWh per £1; the rate of capital expenditure on distribution is becoming steady at a figure of about £21 per 1,000 kWh sold. The actual figure of kWh sold per £1 spent on distribution for any one undertaking is not by itself a criterion of the efficiency of that undertaking. The corresponding figure for the larger companies in the West End of London, where street work is very expensive, averages about 31 kWh per £1. One company with a big railway supply averages 78 kWh per £1, and one or two of the big local authority undertakings in the East End are about the same. For overhead distribution in rural districts, if energy is offered at reasonable rates, the sales should average, at least, 60 kWh per £1 of capital on the distribution system and a much greater amount when domestic and other supplies have been developed more intensively. Looking to the future and bearing in mind that the load factor of most supply undertakings should be very greatly increased, it appears that the kWh sold per £1 should, on the average, increase from the present figure of 47 to between 70 and 80, and the amount of distribution capital per 1,000 kWh should fall from £21.2 to between £12 and £14.

The present sale of 47 kWh, representing 160,000 B.th.u. per £1 of distribution capital, compares with a sale of 1,120,000 B.th.u. in the form of gas per £1 of distribution capital by the Gas Light & Coke Company. Assuming that each £1 of capital invested in the distribution business requires a return of only 15 per cent. for interest, sinking fund, repairs, maintenance, rates and management, it would appear that a charge of 36d. on this account has at present to be borne by, say, 48 kWh, *i.e.*, ¾d. per kWh, in addition to the cost of generation. The importance of increasing the number of units sold per £1 of capital invested in the distribution business is evident, therefore. The extent of the demand in many districts depends, to a great measure, on the price at which electricity is offered. The relationship between the number of kWh sold per head of population and the average revenue obtained per kWh for private supply in the areas of most undertakers in Great Britain indicates that for an average revenue of from 10d. down to 3d. per kWh, the average sales increased from 20 up to 60 kWh per head. The lower the average revenue per unit the more rapid is the increase in the number of units sold per head, being about 110 kWh per head at 2d. per kWh and 170 kWh per head at 1¼d. No undertakings with an average revenue of 1¼d. or less are selling under 200 kWh per head. It may be argued that high consumption is the cause of low average revenue, but against this must be pointed out that a high consumption cannot be obtained unless a low price is offered as an attraction, and it is, therefore, the duty of the supply authority to take the initiative. A further argument is often used that these results can only be obtained in areas where large quantities of electricity are required for power, enabling distributing authorities to supply cheaply for domestic purposes also. There is a certain amount of truth in this argument as long as the generation of electricity remains with the owners of small and inefficient stations. From such stations it is impossible to offer a low tariff to domestic or other consumers. With the concentration of generation which is now likely to take place, it seems very probable that in the next few years not less than 50 per cent. of the total revenue will go towards distribution charges, as compared with 36.5 per cent. in 1922-23. In that year approximately £13,000,000 out of a total revenue of £35,500,000 was allocated to distribution and of this amount no less than 60 per cent. represents capital charges. This again emphasises the necessity of increasing the sales of units per £1 of capital invested. The numbers of persons employed in the generation and distribution sides were about equal, but it seems clear that the percentage employed on distribution will very soon be the larger. A new distributing authority starting operations at the present time should be able to obtain a bulk supply from a modern generating station of reasonable size at a fixed charge of, say, £4 per kW of maximum demand and a running charge of, say, 0.2d. per kWh sold. This method of charging is adopted almost universally in connection with bulk supplies from one undertaking to another, but where an undertaking owns both the generating and distribution systems in any area, the accounts are not generally kept in such a form that this two-part tariff can be readily ascertained. This is a great disadvantage from the point of view of those responsible for the distribution, as without proper allocation of capital and overhead charges it is impossible to frame tariffs to the best advantage. The undertaker who supplies l.p. a.c. has to invest in transforming plant only £4 per kW of maximum demand (for an average sized sub-station), as compared with £10 per kW for converting plant to provide d.c. The cost of the l.p. mains and services themselves is the same in either case for the same voltage, *i.e.*, an average of £20 per kW of maximum demand. The amount of money spent both on capital and revenue accounts is principally dependent on the maximum demand which the distribution system has to deal with, and all outgoings of this character, therefore, are fixed irrespective of the number of kWh sold. On the other hand, the losses of energy in the transmission and conversion system are almost entirely dependent on the number of kWh sold and the cost of the lost energy has to be added, therefore, to the kWh charge of the bulk supply. The following table shows the amount which has to be allowed to meet the cost of a reasonable sized distribution undertaking at various stages, and the approximate percentage which has to be added to the bulk supply kWh charge in order to cover the losses of energy :—

Charges for Transformation, Conversion and Distribution.

	Rate per kW of maximum demand. £	Percentage to be added to "unit" charge.
Main transmission	0.5	3
Conversion to low-pressure a.c. ...	0.4	7
Conversion to d.c.	1.3	14
Low-pressure distribution	2.2	9
Allowance for management, rates and sundries	0.8	1
Total costs of distributing authority for l.p. a.c., excluding cost of bulk supply and without allowance for diversity factor	£3 18s. per kW	20%
Total costs of distributing authority for l.p. d.c., excluding cost of bulk supply and without allowance for diversity factor	£4 16s. per kW	27%

It is a fair assumption for an average case to allow a diversity factor of 1.33 on the kW charge. Therefore, assuming that a bulk supply is available at the price already referred to (£4 per kW), the tariff for a l.p. a.c. supply delivered to consumer's premises will be £4 + £3.9/1.33=approximately £6 per kW of consumer's maximum demand. Likewise, if the bulk supply "unit" charge is 0.20d., this will be subjected, in the case of a l.p. a.c. supply, to an increase of 20 per cent., making the retail price, say, 0.24d. per kWh sold. The lower the "unit" charge in the bulk supply tariff, the more possible will it be for the distributing undertaker to make his tariff attractive for consumers requiring a large number of kWh at a very cheap rate. Similarly for a l.p. d.c. supply, the tariff works out at £6 12s. per kW of maximum demand and 0.254d. per kWh sold. It is necessary for the distribution authority framing tariffs to divide up its costs in this manner, to ensure in formulating rates for off-peak supplies that the running charges in connection with the supply are amply covered. Any authority which can formulate attractive tariffs to sell electricity within the above price limits is sure of a large business. It is probably impossible for any existing undertaking where capital has already been spent, and mains and other apparatus have to be kept in working order, to reduce distribution expenses, management, rates and taxes and capital charges, but it can adopt tariffs which will enable more energy to be sold from the existing equipment and maintain this policy for all future capital expenditure. Over 44 per cent. of the total revenue is received from domestic consumers. This represents rather less than 18 per cent. of the total energy sold in 1922-23, and the average revenue from those consumers was 5.3d. per kWh. The sales amount to less than 20 kWh per head of population served with domestic supplies. Distributing authori-

ties are sometimes unwilling to offer a low tariff for cooking purposes, because they are afraid that they will be involved in very heavy capital expenditure for increasing the size of their mains and the low rates may ultimately prove unremunerative. Some tests which have recently been carried out in the United States revealed that as the number of electric cooking ranges rose from 5 to 1,500 the diversity factor improved from 2.05 to 5.00. The average maximum demand per range fell from 1.75 to .72. An average small household will use from 5 to 8 kWh per day for cooking and the annual consumption may thus reach a figure of 500 or 600 kWh per head of those supplied. Even at the high figure of 1d. per kWh, this means an expenditure of only, say, 4s. per week, which compares favourably with other methods of cooking.

A valuable addition to the electric cooker is the water heater, and the introduction of this apparatus on any system will have a still more marked effect in improving the load factor. In order to limit the load of any household so equipped, a two-way switch can be fitted, so that the electric oven and water heater cannot be connected to the mains simultaneously. Residential consumers' load factors of nearly 30 per cent. have been recorded with equipment of this description, and the load factor of an undertaking in a residential district may thus be increased from the usual figure of 15 per cent. or 20 per cent. up to 40 per cent. or 50 per cent. In order to attract the domestic consumers, it is essential to frame a tariff so that if their equipment has a really good load factor, they will get their supply at an average price of, say, ½d. per kWh or less. The two most successful methods are probably charges based on the floor area of the premises supplied and on the rateable value of the premises. If it were not for the great variation in the assessment of similar-sized property in the same area, the latter would undoubtedly be the more simple method, and it has been used in many cases with success. On this method percentages varying from, say, 10 per cent. to 20 per cent. of the rateable value with a "unit" charge of from ½d. to 1d. per kWh are quite common. An estimate should be made of demands and sales for any district, to ensure that any necessary capital expenditure is fully covered. Many undertakings are now offering supplies to "all electric" houses upon terms under which the average price per kWh is well under 1d. In the fixing of tariffs for a.c. supplies in general, consideration must be given to the power factor of the consumer's apparatus. In the case of larger industrial supplies, it is open to the authority to install kVA maximum demand indicators, but it is preferable that the consumer should alter, or add to, his installation in such a way that his power factor is brought near to unity. In the case of domestic consumers, this question is not likely to arise. Every distribution undertaking should make a systematic investigation of the potentialities of its district, and whenever new apparatus is put on the market the undertaking should study the application of such apparatus to its district. The importance of obtaining a well-balanced income is paramount, so that fluctuations of prosperity in any one industry will not cause wide variations in the total income. Special study should be given to such uses of electricity as will contribute most to an improvement of the local load factor, and rates should be based accordingly.

Inertia of consumers has to be overcome by advertising, demonstrations, loans or hire of apparatus, &c. A properly-developed rate system can be made responsible for producing a higher load factor, and not enough study has been given to this subject by sales engineers. It is often maintained that, owing to the low thermal efficiency of conversion, it is very wasteful to distribute electric power. The modern generating station, however, has a thermal efficiency of well over 20 per cent., and during the past year one of the largest stations in the country reached 22 per cent. The distribution of electricity does not entail any very serious losses; taking as an example a generating efficiency of 21 per cent. and 15 per cent. losses in the distribution system, the consumer obtains 18 per cent. of the heat value in the coal. The consumer has the great advantage that, for whatever purpose he wishes it, he can use electricity at a very high efficiency, combined with great ease of control and absence of fumes and ashes. The large generating station of to-day can be equipped so as to use, with advantage, the cheaper classes of coal which are on the market, whereas the individual consumer requiring coal for furnaces or domestic purposes has to pay two or three times as much for suitable fuel. There are very few, if any, installations at the present time which can compare with a bulk supply of energy derived from a modern high-efficiency generating plant. Important though coal conservation may be, it is more important that our industrial population should work under the most efficient conditions and that their homes should be equipped with all reasonable aids to labour. By all means let us see that all coal that is used for electricity production is used in the most efficient manner possible, and that the electricity so produced is distributed to the consumers with the least possible loss. But having done that, do not let us hesitate to recommend the use of electricity for any purpose whereby the efficiency of production in its broadest sense and the amenities of life in general can be improved, merely because it might be possible to use less coal or no coal at all by doing the work in some other manner.

In many instances in this country the areas are much too small. Where such areas can be extended to a more economical size the defect can be remedied, but in other cases the supply areas of neighbouring towns adjoin one another, and little or no extension is possible. In such cases concerted action between adjacent authorities is most desirable. Those whose generating stations may no longer be required should not look upon the taking of a bulk supply as a curtailment of their activities, but rather as a setting-free of their energies for a more active development of electricity supply. We are on the eve of very great electrical developments, and in order that these developments should proceed on the right lines, the distribution side of the business needs the most careful and capable guidance.

Discussion.

Professor E. W. MARCHANT (Liverpool University) said that the paper demonstrated how much the modern electrical engineer had to deal with economics, and he urged that training in economics for engineers was a matter to which considerable attention should be devoted. Discussing the influence of a reduction in tariff upon the consumption of electricity, he mentioned his experience in his own home as an example. Until this year the annual consumption had amounted to about 1,500 units, but this year it had increased to about 9,000 units, owing to the adoption of electricity for all domestic purposes, as the result of a reduced tariff. So long as electricity was a rather expensive luxury, he said, it would be used for comparatively few purposes, but as soon as the price was reduced to the neighbourhood of about ½d. per unit, consumption would increase enormously. He had been told by an engineer who had recently returned from Chicago that in that city a very large proportion of the total load was due to domestic appliances, and not so much to industrial power distribution. In expressing disagreement with Mr. Kennedy's statement that the efficiency of electric lighting was about 100 per cent., he said that the actual lighting energy which came out of an electric lamp was only about 10 per cent. of the electrical energy put into it, and although there had been vast improvements made in the last few years, they had a very long way yet to go. Discussing the diversity factor of domestic appliances, he said he had figures relating to the diversity factor of a cooking load as high as 12. It depended, of course, upon the district supplied. He also disagreed with Mr. Kennedy's remarks as to coal conservation, and believed that the use of gas and electricity in a house involved no waste of coal. His experience was that if one estimated the amount of coal used to produce either the electricity or the gas for domestic purposes, it was less than the amount used domestically in the raw state. The amount of coal consumed when he used electricity or gas in his own home was about 80 per cent. of the amount used when he burned raw coal in the grates, so that the ratio was in the neighbourhood of 8 to 10 roughly.

Professor WM. CRAMP (Birmingham University) suggested that Mr. Kennedy, in dealing with the relation between price of electricity and demand, had put the rationale inside out, and that, instead of trying to increase demand in order to reduce price, they should reduce price in order to increase demand. Supply authorities in general lagged behind the demand by refusing to decrease the price until such time as they could show that a definite profit would arise from the reduction. If they decreased the price first, the increased demand would arise instantly. The step taken by Mr. Henry Ford with regard to motor-cars might be followed in connection with electricity. In the first year of production Mr. Ford had suffered a loss, but his policy had been to reduce his prices in order to increase demand, and the increased output had enabled him to sell at the lower prices. He agreed that, under the new electricity scheme to be adopted in this country, the distribution costs would bear a larger proportion to the total cost of supply than at present, and it remained to be seen whether that was to be an economical arrangement finally or not. With regard to tariffs, he said that £6 per kW of maximum demand, plus 0.2d. per unit sold, and £6 12s. per kW of maximum demand, plus ½d. per unit sold, would encourage the owners of works with small load factors to take a supply from the public mains, but owners of works with larger load factors would not be encouraged, owing to the disparity between the two parts of the tariff, in view of the modern generating plant which they could install to generate their own power. The relationship between the two parts of the tariff would have a very great bearing on whether the public electricity supply would be used in industrial concerns. In the case of a works with an 80-per-cent. load factor it would be difficult to prove that it would pay to adopt the £6 plus 0.2d. tariff, because private plant would look more economical, at least on paper. In the case of an engineering works with a load factor of 15 per cent., such a tariff would be of benefit, but it would be still more attractive if the charge per kW of maximum demand were £4, and the charge per unit 0.3d. If the tariff were to be sufficiently low to tempt the man with the small load factor, how could the Electricity Commissioners expect the load factor of the country to go up except in so far as the diversity factor was improved? Tariffs must be designed to suit both the large and the small works. Commenting on the opinion which seemed to have got abroad in this country that heating water by electricity was an uneconomical proposition, he said that an automatic installation, in which the current was switched off when the water reached a certain temperature, compared very well with other water-heating systems. He had made a comparison between an electrical and a gas water-heater, and had found that with electricity at about ½d. per unit the electric heater would certainly save a good deal of money, as compared with the gas heater. In order to get a reasonable supply of hot water electrically, automatic installations, in which the current was switched on for long periods of time, must be used. The quantity of electricity running through the installation day and night was very small, and very satisfactory automatic switches were now available. In a small household, the current running normally in order to keep the temperature of the water at 92 deg. C. was considerably less than that used by an ordinary electric iron.

Mr. KENNEDY, replying to the discussion, said he was glad to hear from Prof. Marchant that the use of gas and electricity in the home instead of raw coal did not involve an increase in coal consumption, because there were a lot of people, including the Fuel Research Board, who did not agree with that. He agreed with the contention that the supply authorities should decrease prices in order to bring about an increased demand, and that the lagging behind on the part of the electricity supply authorities was in many cases delaying electrical development. If they reduced the prices and offered attractive tariffs, increased demand would follow. He had not suggested that, as the result of the new arrangements embodied in the new Electricity Bill, distribution costs would increase, but that a greater percentage of the total cost would be represented by distribution because the total cost per kW of maximum demand would be less, owing to the concentration of generation. Finally, Mr. Kennedy recalled the fact that 32 years ago his father, Professor Kennedy, was President of Section G of the British Association. In his presidential address there was practically no reference to electricity, whereas on the present occasion the president "oozed electricity from every pore."

Electric Ploughing.

By R. BORLASE MATTHEWS, Wh.Ex., A.M.Inst.C.E., M.I.E.E.

(Abstract of paper read before Section G.—Engineering.)

It is not so universally appreciated as it should be that agriculture requires more power than all other industries combined. Of this, by far the greater portion is required for cultivating the soil.

Not only is ploughing one of the most important and heaviest of farm tasks, but it is also the most expensive item in the arable farmer's bill; in fact, it is more costly than the manure which is used on the land. The economics of the question have arrived at the stage where it is necessary for the engineer to step in. Increasing the rate at which the work is carried out seems to offer the greatest benefit. Results have shown that the cost of the extra power required to perform any cultivation at a higher rate than is usually done to-day, is much less than the amount saved in labour and other costs. It is therefore important to examine what contribution electricity can make towards solving the problem.

Continental engineers have given a great deal of attention to this matter, with the result that there are over 200 electric ploughs in use on the Continent to-day. Successful as these engineers have been, there is still a great deal of research and experimental work to be done, not only in the method of using electric power, but also in the re-design of the actual implements.

Opposition to all kinds of mechanical power for ploughing is sometimes met with in agricultural circles, on the ground that it is absolutely necessary to have a number of horses about a farm for hoeing, harvesting and general carting. It is therefore claimed that the introduction of power-driven cultivating machinery, instead of reducing costs, would of necessity increase them, as the keep of the horses would be the same and the mechanical power would only be carrying out work the horses would otherwise be doing, with the result that the horses would be standing idle for a considerable part of the year, while the machines were doing the work. This would be a strong argument if the work of ploughing could be extended over a long period, and if the horses were only used for this purpose during slack periods, but this is far from being the case. For land to be well cultivated, it is necessary to get the ploughing completed as early as possible in the autumn, and, again, it often occurs in England that long, wet periods are experienced, which delay work on the land, so that it is a great advantage, when a favourable opportunity presents itself, to have something quicker than the horse to carry out the work.

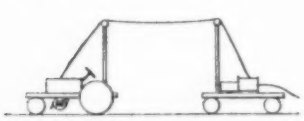


Fig. 1.

Electric tractor with bare overhead conductor and automatic reel at side of field.

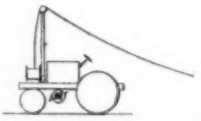


Fig. 2.

Electric tractor with trailing cable, automatic reel on tractor.

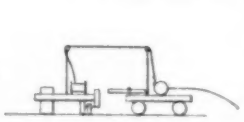


Fig. 3.

Electric tractor with trailing cable, automatic reel on tractor and automatically movable self-winding supply point at centre of furrow.

As scientific methods of farming are increased, there will be a still greater need for some quick and cheap method of ploughing, so as to enable the farmer to take full advantage of the new methods. For instance, on the author's farm, where his new system of artificial curing of hay and cereal crops is carried out, the crop is carried within a few hours of cutting and afterwards cured in the rick. One of the advantages of this system is that the field is cleared immediately the crop is cut, and ploughing is begun at once. The enterprising farmer of the future, having adopted these new and efficient methods, will not be prepared to use the horse plough and so lose the valuable time he has gained.

The rotary cultivator is making rapid progress—there are over 500 in England alone to-day. The efficiency of the present-day plough is very low, and its design has been more on a rule of thumb basis than upon modern scientific and mathematical research. The matter is complicated by the fact that the soil has not the uniform characteristics of water or air. In fact, in one and the same field there is always a very great variation in the properties of the earth.

There are a number of different systems of electric ploughing in operation to-day, though they practically all fall into one of two classes, *viz.*, tractors or rope haulages.

When electric tractors are connected to supply mains, one of the main problems is the method of dealing with the feeder cable. Dragging the cable on the ground has not proved satisfactory, as the cable is easily run over and damaged. It is also worn very quickly.

Electric tractors fitted with a tram-car type collecting trolley or bow that picks up the current from a bare overhead conductor have not proved satisfactory, chiefly on account of the trouble in designing the supports so as to maintain sufficient tension on the conductor and at the same time to facilitate progressive movement at the end of each furrow. This method has been tried for lawn mowers by Mr. Turnbull at Aylesbury.

The suspended bare conductor, with automatic friction controlled winder on a stationary feeder wagon fig. 1, has been employed in Sweden for some time. The cable runs from a transformer cabin to a special cable trolley, on which a mast is fixed; a bare conductor runs from the mast to the tractor. The overhead line consists of three bare, tough, aluminium alloy strips, spaced apart with insulating material. The trolley is placed at a suitable point for supplying the whole field, and the overhead line is kept at a definite tension by means of a motor on the trolley, which is kept continuously running. The tractor is fitted with a full creeper track. The motor is of the 500-volt, 15-h.p., 3-phase induction type, and propels the machine at a normal speed of 2¼ miles per hour.

A machine representing a considerable improvement in electric plough design has been designed by N. Forssblad of Sweden, fig. 2. The main driving motor of the tractor is of 30 h.p., three-phase, with controller, and oil switch with overload device. The cable drive is operated by an additional small motor through a friction drive, the motor being provided with a special hysteresis control rheostat. When the tractor is driven away from the source of supply, the cable is drawn out against the friction drive. When the tractor returns the cable is slackened, and as the resistance to the motor is thus removed, the motor comes into operation and winds up the cable. Owing to the hysteresis control, the operation of the motor is automatic, and it does not tend to burn out when it is stationary. A tractor of this type, with three shares, will plough, on an average, six acres per day to a depth of 8 in. The current consumption is about 28 kWh per acre.

Major A. McDowall has recently developed an original form of creeper tractor which falls into this group of automatic cable winders (fig. 3). It has the great advantage of minimum wear on the cable, as it is provided with an automatically movable self-winding supply point. The tractor also incorporates a novel method of side-stepping the whole machine, ready for the next furrow.

Electric tractors hauling on a chain laid across the field, anchored at the ends, have not proved very popular. They introduce the difficulties of anchorage without removing the weight of the haulage gear from the soil, as the round-about systems do.

The steel wire-rope electric haulage systems have a number of advantages over all others when employed as large and very powerful units. The chief of these advantages are that the tractor does not pass over the soil, and the plough is of the anti-balance type, which means a great saving in time as compared with the time taken by most tractors in travelling over the headlands for turning purposes. Where a system of rope haulage is used, double-ended anti-balance ploughs are employed, one set of shares being in operation while the other is in the air, ready to be dropped for the return journey. This avoids any necessity for turning the whole implement at the end of each furrow. The only limiting factor in the length of the furrow is the distance at which signalling can be conveniently done. In practice, this seldom exceeds 440 yards, owing to mist, slight hills in the land, &c.

A double-haulage system, with two single-drum winders, one progressing up each side of the field, is perhaps the most popular type of equipment with farmers, co-operative societies and ploughing contractors (fig. 4). Its capacity for work is enormous; it will plough up to 30 acres in one day, as compared with a bare acre for a team of horses. One of the best examples of this type of equipment is supplied by the Société Générale Agricole, of Paris, and has been in use in France for a number of years. Each set is fitted with either an 80, 100, 125 or 150-h.p., 5,000-volt, three-phase, slip-ring, induction motor, which is protected against rain and is capable of a momentary overload of 60 per cent. The makers supply the whole of the necessary equipment, including haulages, plough, transformer wagons, flexible cable and hooks for tapping the high-pressure line. An auxiliary petrol engine of 50 h.p. is fitted to each set for moving it from place to place. This type of equipment is often drawn into position by animals, though, in case of difficult ground, it can be made to haul itself along by its own ropes and tackle. Another double-haulage equipment used in France is that designed by Estrade. Each set is equipped with a 35-h.p., three-phase, squirrel-cage motor, which can be coupled to the wheels so as to move the haulage. It is designed for two speeds of 1.83 and 2.75 miles per hour.

This is much lighter and less expensive than the previous set. It is capable of ploughing six acres in an eight-hour day. A special feature of this equipment is a very ingenious anchoring device, which permits of comparatively light weight haulages. The haulage cable passes over a pulley at the end of a pivoted arm. The greater the tension of the cable, the lower will be the position of this arm and the point of application of the pull. The downward movement of the arm is resisted by a system of oil dash-pots, so that for every value of the pull there is a position of equilibrium, such that the resultant of the pull and the weight of the haulage always passes through the points of contact with the soil of the two inside wheels. The wheels are fitted with flanges, which, with the rims, enclose a prism of earth, so that instead of depending on the friction of iron on earth, the much greater friction of this compressed prism of earth on that lying beneath is utilised.

A two-motor equipment is also supplied by Siemens Schuckert, and consists of two winding trucks (fig. 4). The drum for the steel cable is mounted on the winding truck and is equipped with a powerful automatic brake for paying out the cable; there is also an auxiliary brake for the operator's use, which can be released instantly. An 80-h.p., 750-volt, three-phase motor is used for driving the gearing of the

Fig. 4.

Double haulage system, with two single-drum progressing winders.

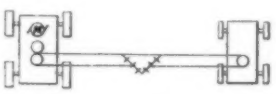


Fig. 5.

Modified double-rope, single-haulage system with one single-drum progressing winder and one progressing anchor carriage.

cable drum. The resistances, which consist of cast-iron grids, are placed in a separately-arranged iron frame. The fuses on the motor are capable of taking from two to two and a half times the normal current, so that the motor will not stop every time a current surge occurs. The cost of the complete equipment, including two winding trucks, transformers, cable, plough, &c., is about £4,500. A five-share balance plough is used, which has a working width of about 6 ft. 6 in. and a working depth of from 8½ in. to 16 in.

It is claimed that with these sets the energy consumption for depths not exceeding 7 in. is as low as 15 kWh per acre; this is an exceptionally low figure, as compared with other equipments. Four men are required for the operation, two being needed for the winding trucks, one for operating the plough, and the fourth as a help when fixing the plough in the new furrows. The winding trucks are sometimes equipped with a 20-h.p. petrol motor for travelling from place to place.

A single-winder system is also used in some areas on the Continent (fig. 5); this is really a compromise, both in cost and size, between the double-winder and round-about systems. An anchor wagon of special design, having wide cutting flanges on the wheels and loaded with a weight of ballast, is used at the opposite side of the field and so displaces one of the winders.

Another very suitable method is to be found on some French farms. It is an anchor-pulley method, which, though old from the steam tackle point of view, is comparatively new as an electrical method (fig. 6). The haulage wagon is equipped with a single 60-h.p. motor and two haulage drums, either of which can be operated by the motor while the other pays out the rope. It is stationary at about the centre of one side of the field to be ploughed.

The haulage rope is arranged, by the aid of suitable pulleys, to follow round the sides of the field. At the two corners nearest the plough, anchor pulleys are provided, while at the other two corners anchor wagons are used, from which an anchor rope is taken to the end of the field. When the haulage rope is pulled along, the wagons are drawn along to the extent permitted by the slack in their anchor ropes. The balance plough is attached to the haulage rope, between the two pulley wagons, and is hauled from one pulley wagon to the other. Upon completing one set of furrows, the plough is tipped ready for the next set. The anchor rope of the farther pulley wagon is now slackened out, thus permitting this wagon to travel a distance of twice the width of the new furrows. The plough is then drawn over to this farther pulley wagon. In this way the pulley wagons gradually approach the hauling sets, as the ploughing proceeds.

The length of the cable supplied with these ploughs is sufficient to plough 40 acres without moving the haulage wagon. Operating the plough is a comparatively simple task, which can be performed by any farm worker. This system is very suitable, both for the farmer with an average size farm and for the power company supplying the current. As the motor is only of about 30 h.p., it is likely that a number of motors of this size would operate in the same district, so that the power station would supply, say, five 30-h.p. motors in place of one 150-h.p. motor, and the peak loads of 30-h.p. motors would be much better distributed, giving a most uniform load.

The Douilhet system differs from the previous one, in that it replaces the anchor wagons by two simple pulleys, and the anchorage is obtained by burying pieces of timber in the ground to a depth of 3 ft. (fig. 7). It is a modified apparatus of this type, fitted with a 12-h.p. motor, that is now in use on the author's farm at East Grinstead, in an attempt to solve the problem for the small farmer. With this system, ropes, fixed and anchored at each end, run along each of the two sides of the field, at right angles to the direction of ploughing. A clamp is fixed on each rope and acts as a stop, beyond which the anchor pulleys cannot slide when the strain comes upon them. These clamps are moved towards the haulage set, a distance equal to the width of the new furrows ploughed at each traverse. This system requires only one man to operate the complete apparatus, as the author has devised a method whereby an insulated cable is included in the haulage rope, and contactors, controlled by a switch or push button, operate the electrical gear. For fields ploughed every year, it is cheaper to leave the angle irons or logs of wood permanently in the ground.

As a result of the author's tests carried out on his own 600-acre farm at Greater Felcourt, East Grinstead, and his investigations in all Continental countries where electrical ploughs are in use, he has concluded that the most suitable equipment for the individual farmer, with 150 acres and upwards, would be an electric tractor with a half-creeper track, a storage battery, a trailing cable, an automatic reel on the tractor, and an automatic and movable supply point at the centre of the furrow supplied from the side of the field (fig. 3).

The tractor system is preferred because it avoids the work entailed by anchorages. The storage battery will supply the power for moving the equipment from field to field, and it also allows the tractor to be used at other times for general haulage purposes. The creeper track is of special importance, as it avoids the compression of the soil due to the weight of a wheeled tractor, and it becomes possible to reduce the pressure on the soil to less than that due to the weight of a man's foot.

A mast should be fitted to the tractor so that the cable which is feeding the tractor from the movable supply point (which should also be provided with a mast) may hang free in the air for, say, 40 yards. In this way all risk of the tractor running over its cable is obviated, and wear and tear are eliminated. A tractor of this type could deal with 50 to 60 acres from a single contact in the middle of the field and furrows half a mile long could be ploughed. Even if it were desired to plough a longer distance, it would only be necessary to attach another length of cable.

A tractor of this type could also carry out such work as cultivating, harrowing, rolling, seed drilling, harvesting, &c., as well as act as a road transport vehicle.

The following figures were given in the report of the Institution of Electrical Engineers' Electricity in Agriculture Committee (of which Committee the author is a member) as generally accepted British prices for work about 6 in. deep (according to the nature of the land :—

	Per Acre.
Steam ploughing	15s. to 25s.
Tractor ploughing	17s. 6d. to 30s.
Horse ploughing	20s. to 35s.

As there is so little electric ploughing in this country, it is necessary to compare these prices with the contract price for electric ploughing in France. The following are the 1924 prices, according to Hubert :—

Depth. Ploughing in.	Subsoiling in.	Total depth in.	Price per acre. Francs.*	s.	d.
10-12	5-6	15-18	137	34	3
8-10	5-6	13-16	130	32	6
12-14	—	12-14	127	32	0
10-12	—	10-12	120	30	0
6-8	5-6	11-14	120	30	0
8-10	—	8-10	93	23	0
6-8	—	6-8	66	16	6

* 80 francs to £.

The charge for scuffling to a depth of 4 in. is 40 francs per acre.

Any attempt at making actual comparisons is likely to be misleading, owing to the number of assumptions that must be made. However, the author suggests that the following

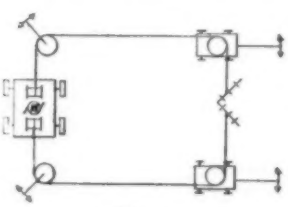


Fig. 6.

Round-about or anchor pulley single-haulage system and progressing anchor carriage pulley.

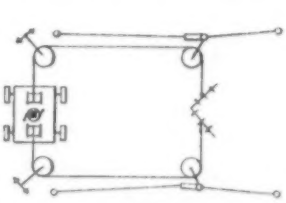


Fig. 7.

Modified round-about or single-haulage system with two anchor pulleys and two progressing pulleys positioned by clamps on fixed side cables.

figures give a fair basis for judging the comparative costs of ploughing by electricity and with an internal-combustion engine.

The consumption of electrical energy is taken as 22 kWh per acre. This is the average figure on the Continnent, though it would be in the neighbourhood of 15 kWh in England. The efficiency of the motor and transmission of the electric tractor is taken as 75 per cent. The thermal efficiency of the internal-combustion engine is approximately 14 per cent.

The fuels used are :—

	Calorific value in B.th.u. per lb.	Specific gravity.	Price per gallon.
Petrol	19,900	0.7	1 2
Paraffin	18,900	0.8	0 9½
Fuel oil	18,000	0.9	0 5½

Allowance for lubricating oil :—
3½d. per acre with petrol
4½d. ,, ,, paraffin
8d. ,, ,, fuel oil.

The cost of electrical energy is taken at one penny per kWh. In both cases the area ploughed in one day is five acres. Cost of labour on internal-combustion tractor, 8s. 6d. per day, and on electric tractor, 6s. The figure for the internal-combustion tractor is estimated higher, since more skill is required for driving and additional labour is necessary for carrying fuel and water to the tractor.

Depreciation.—Oil-engine driven tractor with plough, first cost £475, replaced in five years.

Electric tractor with plough, but without cable, first cost £500, replaced in fifteen years.

The times for replacement cannot be considered unreasonable, since it is well known that the electric motor has a very long life, and always gives a very smooth drive.

The interest on capital is taken as 6 per cent.

Work done per year : 200 days at 5 acres per day = 1,000 acres.

Repairs and maintenance of engine-driven tractor, £40.

Repairs and maintenance of electrically-driven tractor, £20.

An additional sum of £24 per annum should be added for the electric tractor for wear on the cables and replacement every two years.

Cost per Acre.—The 22 kWh required by the electric tractor will produce at the axle $0.75 \times 22 \times 3,400 = 56,000$ B.th.u.

The following quantities of fuel are required to do the same amount of work :—

Petrol : $56,000/0.14 \times 19,900 = 20.1$ lb. = 2.9 gals.
Paraffin : $56,000/0.14 \times 18,900 = 21.2$ lb. = 2.7 gals.
Fuel oil : $56,000/0.14 \times 18,000 = 22.2$ lb. = 2.5 gals.

Comparative costs are given by the following table :—

	Internal-combustion tractor.			Electric tractor.
	Petrol.	Paraffin.	Fuel oil.	
Cost of—	s. d.	s. d.	s. d.	s. d.
Fuel	3 5	2 2	1 2	1 10
Engine lubricating oil ...	0 3½	0 4½	0 8	—
Labour ...	1 8½	1 8½	1 8½	1 2½
Repairs ...	0 9½	0 9½	0 9½	0 5
Cable ...	—	—	—	0 5½
Depreciation..	1 11	1 11	1 11	0 8
Interest ...	0 7	0 7	0 7	0 7½
	8 8½	7 6½	6 10	5 2½

To the above, of course, must be added the usual overhead charges. The table shows that, with electricity at one penny per kWh, electric ploughing is cheaper than petrol, paraffin, or fuel-oil tractors, and to this should be added the further saving due to the fact that breakdowns are far less frequent, thereby permitting longer hours in the field.

The advantages of electric ploughing may be summed up as follows :—

(1) Practically unlimited power is available behind the plough; thus any obstruction within the power of the plough can be overcome.

(2) Deep ploughing is possible, an important factor in the growth of sugar beet, sugar cane, &c.

(3) The cost per acre for electric power is considerably lower than for the fuel in non-electric types of plough.

(4) Low labour costs, as compared with other forms of fuel, *e.g.*, the work of carrying fuel and water is entirely eliminated.

(5) Evenness of ploughed land, which gives a flat surface on which water will distribute itself.

(6) Increase of marketable produce. Prof. Fletcher, of the University of California, states that on farms where there is no mechanical power, 24 per cent. of the wheat, 67 per cent. of the oats, and 44 per cent. of the hay produced, are consumed by the working animals.

(7) During favourable weather, whole areas can be ploughed quickly.

(8) When the electric cable systems are used, the ploughed land remains light and aerated, and the machines do not traverse the main portion of the land.

(9) The ploughing load is practically essential in the development of rural electrification; when combined with threshing it provides a load for about 200 days of the year, and the amount of the load is from two to three times that required for all other purposes.

A great deal of arable land is being turned into pasture owing to the high cost of cultivation. This national calamity can be averted by the introduction of the cheaper and more economical electrical method.

From what has been said, it will be appreciated that electric ploughing is a serious proposition which it is well worth while to tackle. Its problems are not so difficult as might at first appear, for much experience has been gained from the electric ploughing work done in other countries under commercial conditions. Thus it is not too much to hope that in this country, provided we take advantage of the experience at our command, we may bring to fruition plans which will undoubtedly serve a turn in the solution of our agricultural problems.

Discussion.

The PRESIDENT, opening the discussion, said he was glad to find that Mr. Matthews disagreed with the view that agriculture did not offer a large field for the application of electricity. Agriculture was, after all, our biggest industry, and anything which would tend to arrest the appalling reversion from arable land to pasture, which was making us more and more dependent upon other countries for our foodstuffs, ought to be assisted.

Mr. W. COULMAN BROWN (Honorary Judge of agricultural implements to the Royal Agricultural Society) said the author seemed to imagine that ploughing was getting out of date, and that they were moving towards rotary tilling. His experience, however, was that ploughing could not be abolished unless summer fallowing also was abolished; but without summer fallowing it was impossible to keep the land tilled. In his district a lot of arable land was going over to grass, and a lot more would go unless there were cheaper methods of working, brought about by the greater use of electricity or other power. The rotary tiller was a good instrument, but the chief difficulty was that it cost £2,200, so that it was too expensive for farmers to buy.

Professor E. W. MARCHANT (Liverpool University) expressed admiration of the enthusiasm which Mr. Borlase Matthews had shown in his experiments on the application of electricity to agriculture. His work, in time, would prove of enormous value, because unless experiments of this kind were made by somebody who could really tackle them from the electrical engineering standpoint, there seemed no hope of the full development of electricity in agriculture. He was glad to hear that electric ploughing could be used on 200 days during the year, because the difficulty with the use of electricity on the farm was the very bad load factor, and if electric ploughing could be adopted, presumably the load factor would be very sensibly improved. The drawback to electric ploughing seemed to be the capital cost involved. Discussing the relative costs of electric, petrol motor, and horse ploughing, he said it would appear that savings in cost could be effected with regard to electric ploughing by the co-operation of farmers in a neighbourhood, and if that had not been taken account of in the figures put forward in the paper, it gave electric ploughing a further advantage over other systems.

Mr. J. R. BOND (Examiner in Machinery for the National Agricultural Examination Board) also congratulated Mr. Borlase Matthews on the research work he was doing—not at the public expense. The principles of tillage, he said, were the same, no matter whether horses, tractors, or electric power were used, but there were undoubtedly advantages in possessing a reserve of power, so that the work could be done at the right time. That was more important than the matter of choosing the particular method to be used. The operations which had to be carried out were sometimes beyond the power of a horse team; the horses tired and needed rest, perhaps at a time when they were most wanted, but a machine with a reserve of mechanical power could be used continuously and as long as was necessary. The real point, however, was that of cost, and farmers wanted to know whether electric ploughing involved less initial outlay than the systems at present in use. Another point was the weight associated with a machine of a given power; the land was not always in a fit condition to carry 12 or 15-ton engines with steam tackle. Finally, he asked whether the cables presented any difficulty in the matter of transporting an electric plough from one field to another.

Mr. J. H. BLACKABY (Institute of Agricultural Engineering) suggested that, even if ploughing could be done more quickly by electricity than by other means, the chances were that the work might not be done so well, so that the yield would decrease, and there would be no gain in the long run.

Mr. BORLASE MATTHEWS, replying to the discussion, said that the application of electricity to farming required careful investigation and development. When that development was achieved, they would get the type of result indicated in the paper, and because the matter was so important to the electrical industry as well as to farmers, he considered that the whole problem needed to be tackled by engineers on engineering lines.

Replying to Mr. Brown, he said he intended to refer to the rotary tiller as a tentative alternative to the plough. He agreed that they could not alter things which years of experience had built up in farming. He held no brief for the rotary tiller, but considered it a very important thing to investigate.

He would not agree with Prof. Marchant that the load factor was not very good on the farm. If the farmer were left to himself it was liable to be poor, but, with proper education of the farmer, the load factor on the farm was really wonderfully attractive. That could be brought about by not allowing the farmer to use machines of more than 5 h.p. each. In one part of Holland, where thrashing was carried out by electrical machines by contractors, the load over six or seven months in the year was 500 kW, as the result of the demand for power for those machines. Electrical power had the advantage that it was more reliable and more foolproof than other sources of power, and he recalled a statement made to him by one farmer who had said that, when using oil engines, and after training his men to look after them properly, he had found that, as a result, they had qualified themselves for better jobs and had left him. They could not qualify themselves for another job by the mere action of pressing a button. There was no difficulty with regard to cables, when ploughing. There were two rolls of cable, 400 and 600 yards long respectively; the alternative was to have a bare flying line. As to cost, it was his opinion that electricity would do more at less cost than other forms of power.

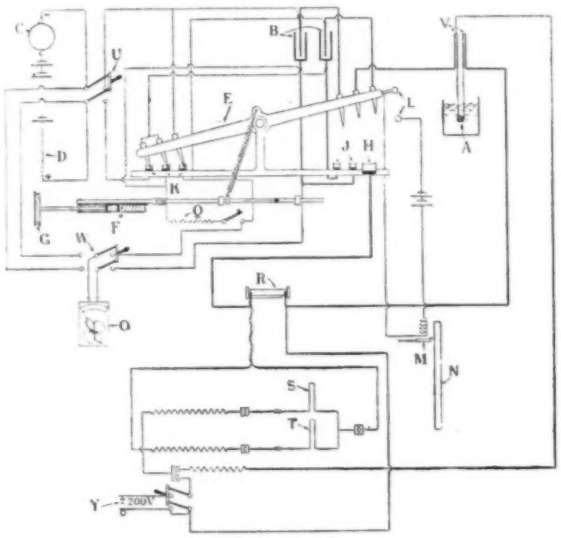
Intense Magnetic Fields.

Some Experiments in their Generation and Application.

By T. F. WALL, D.Sc., D.Eng., M.I.E.E.

THE paper* describes a method of generating magnetic fields of the order of magnitude of 1 million gauss, and of impressing such fields on a specimen of magnetic material at regular intervals, with a view to ascertaining whether any disturbance of the electronic orbits could be obtained of sufficient magnitude to produce a marked effect on the magnetisation curve of the specimen.

In order that the two essential requirements should be fulfilled, *viz.*, that very large currents should be generated in the solenoid winding and that they should only be allowed to flow for a very small fraction of a second, the author decided to use the oscillatory discharge of electrostatic condensers of high capacity and charged to a high potential difference.† The condensers used were of the paper-insulated, oil-immersed power type supplied by British Insulated Cables, Ltd., of a nominal value of 50 μF each, capable of withstanding a charging pressure of 2,000 volts (d.c.); 28 of these units were available, the total capacity when connected in parallel being 1,366 μF. They were charged by a small d.c. generator as built for wireless telegraph purposes, which develops about 1,200 volts and is capable of supplying about 0.02 ampere. In series with this generator were connected a number of small accumulators as used for wireless telegraph work, so that the total available d.c. pressure for charging the condensers was about 2,000 volts.



A = Solenoid exciting intense magnetic field.
B = Condensers.
C = High-voltage d.c. generator in series with high-voltage battery.
D = Buffer resistance.
E = Motor-driven oscillating switch.
F = Worm gearing driving oscillating switch E.
G = Belt pulley driving worm gearing F.
H = Main mercury contact for condenser discharge circuit.
J = Mercury contact cups for connecting condensers in series for discharging.
K = Mercury contact cups for charging condensers.
L = Contact for actuating electromagnet M.
M = Electromagnet operating photographic plate release.
N = Photographic plate slide for oscillograph.
O = Kelvin electrostatic voltmeter for measuring condenser charging voltage.
Q = Auxiliary safety resistance for discharging condensers.
R = Oscillograph standard shunt for measuring condenser discharge current.
S = P.D. strip of oscillograph.
T = Current strip of oscillograph.
U = Switch for high-voltage supply.
V = Non-inductive leads to solenoid A.
W = Switch for electrostatic voltmeter.
Y = A.C. supply (50 cycles) for calibrating oscillograph.

Fig. 1.—Arrangement of Test Apparatus Connections.

The d.c. supply so provided was connected in series with a high resistance (about 0.25 megohm) so that when the discharged condensers were connected to the supply there would not be any heavy rush of current from the generator and accumulators. The condensers required about 3 to 4 minutes to become fully charged under these conditions; they were then connected directly to the solenoid winding within the core of which the intense magnetic fields were to be generated, care being taken to keep the resistance and inductance of the leads from the condensers to the solenoid as small as practicable.

The solenoid was immersed in a bath of transformer oil which served the double purpose of maintaining a high value of the insulation resistance between neighbouring turns of the winding, and of cooling the solenoid winding after the passage of the discharge currents from the condensers, which reached momentary values of many thousands of amperes. The measurement of the very heavy currents has been a problem of some difficulty; the method employed is the Duddell high-frequency oscillograph and "falling plate" camera.

The frequency of the oscillatory current produced by the condenser discharge is measured by connecting one strip of the oscillograph to a source of sinusoidal alternating current of known frequency, whilst the other strip of the oscillograph is in circuit with the discharge current of the condensers. Fig. 1 shows diagrammatically the general arrangement of the connections. The solenoid bobbins were made of ebonite in order to eliminate any extraneous disturbing effects which might have occurred if they had been made of metal. The method of charging the condensers in parallel and connecting them in two groups in series for discharging gives a distinctly larger value for the maximum value of the magnetic field within the core. By carrying this procedure still farther and, for example, by charging the condensers all in parallel and then dividing them into four groups in series before discharging, still higher values of maximum intensity of the magnetic field generated within the solenoid core may be expected.

A noteworthy feature of the data obtained is the large discrepancy between the calculated and observed values in the case of the largest solenoid used. In view of the relatively good agreement in the other cases it appears that some new effect is manifesting itself in the performance of this solenoid. The peculiar phenomenon indicated seems to be equivalent to a reduction in the effective inductance of the solenoid.

In attempting to locate the cause of this it should be borne in mind that the conditions for this solenoid are different from those for the others, in that the magnetic fields generated in its core attain a much greater intensity than those generated in the others. The effect of this is that the mechanical pressure developed between neighbouring turns of the solenoid winding is very much greater; further, the total length of wire in the winding is much greater than in either of the other solenoids.

The conditions therefore may be summarised as follows: In the solenoid there are a large number of turns of wire insulated with cotton and soaked in oil; the turns all become pressed together with very great mechanical force when the condenser discharge currents pass through the winding and, moreover, since the discharge currents are oscillatory, the mechanical force which presses the oil-soaked cotton against the wire will also be a periodic force.

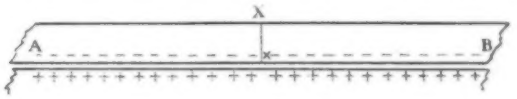


FIG. 2

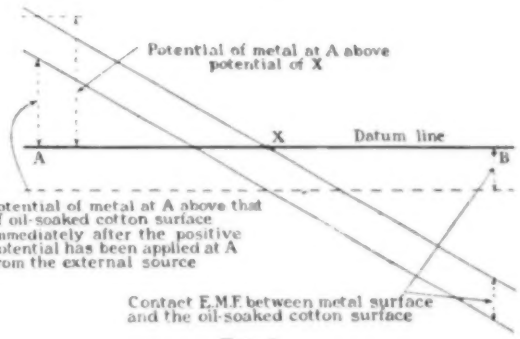

Potential of metal at A above potential of X
X
Datum line
A
B
Potential of metal at A above that of oil-soaked cotton surface immediately after the positive potential has been applied at A from the external source
Contact E.M.F. between metal surface and the oil-soaked cotton surface

FIG. 3.

Figs. 2 and 3.—Illustrating Contact E.M.F.

The author advances the theory that the so-called "frictional" electricity, or "contact e.m.f.," which is developed when any two unlike substances are brought into intimate contact‡ is sufficient to account for the apparent decrease of the inductance of the solenoid as shown by the discrepancy between the measured values of current and frequency and their calculated values. A reduction in the effective inductance would, in fact, mean an increase in the frequency and (within limits) an increase in the current also.

* From the I.E.E. *Journal.—Abstract.*

† P. Kapitza has described (*Proceedings of the Royal Society*, A, 1924, vol. 105, p. 691) a method of producing intense magnetic fields by means of the discharge of accumulators.

‡ See Elihu Thomson: *General Electric Review*, 1922, vol. 25, p. 418; also *Elektrotechnische Zeitschrift*, 1924, vol. 45, p. 878.

Suppose that a strip of metal, A B (fig. 2) is pressed into intimate contact with a layer of oil-soaked cotton wool, and also suppose that (by virtue of the contact e.m.f.) the metal becomes thereby negatively electrified and the cotton positively electrified, as is illustrated by (fig. 3) showing the potential of the cotton by a horizontal straight line below the datum line, the latter being intended to represent the potential of the centre of the metal strip.

Now suppose that a potential difference is established between the two ends of the metal strip, *e.g.*, by connecting them to a source of direct-current supply. Since the oil-soaked cotton is an insulator, it cannot allow a conduction current to pass. The contact e.m.f., however, between the metal and the cotton will tend to remain constant and it follows, therefore, that a current will flow across the contact surface of metal and oil-soaked cotton, which will be so directed as to maintain a uniform value of the contact e.m.f. between the metal and the oil-soaked cotton at every point of the surface of contact. Thus, if the end A of the metal is raised to a positive potential and the end B lowered to a negative potential with respect to the datum XX, there will be a flow of electricity *from the metal into the cotton* at points along the contact surface between the end A and the centre X, and there will be a flow of electricity *from the cotton into the metal* at points along the contact surface between the end B and the centre X.

If now the source of d.c. potential is removed from the ends A B, the metal will immediately become an equipotential surface and (in order that the characteristic contact e.m.f. between the cotton and metal surfaces shall be maintained) there will be a flow of electricity *from the cotton into the metal* at points along the surface between the end A and the centre X, and a flow of electricity *from the metal into the cotton* at points along the surface between the end B and the centre X. It thus appears that the cotton insulation stores up energy and releases it in a precisely similar way to that in which a condenser stores and releases electrical energy.

This condenser effect due to the contact e.m.f. must not, however, be confused with the ordinary self-capacity of a coil. In the case of ordinary self-capacity effects, the condenser is a normal one comprising two conductors separated by a non-conductor; in the case of the contact e.m.f. condenser effects, however, the condenser has only one metal plate, and the cotton surface itself forms the other plate. The distance between the plates thus becomes one of atomic dimensions, and since the contact e.m.f. is relatively high (*viz.*, of the order of 1 volt) it follows that the capacity may become relatively enormous. Preliminary attempts have been made to check this theory, the method adopted being to build up a special solenoid and make one end-flange adjustable so that very large mechanical pressures can be exerted to press the windings into close contact. By supplying alternating current at 50 cycles frequency, endeavours were made to produce a leading current when great mechanical pressure was applied to the end-flange of the coil. Up to the present this experiment has not been successfully accomplished, but it is hoped that it may be possible to renew the attempt at an early date.

An interesting oscillogram was obtained with a solenoid wound on a steel bobbin. The condensers were connected all in parallel, charged up to 2,126 volts and then connected in two sets in series for discharging. The coil burst when the discharge took place and the oscillogram of the sequence of events after the discharge circuit was closed, indicated that the current wave comprised a single peak and then fell to zero; the peak value of the current wave as measured from the oscillogram was found to be 2,230 amperes.

The p.d. wave shown on the oscillogram exhibited some remarkable features; for example, the p.d. became zero at the same time that the current fell to zero, and remained zero for about 0.002 sec. The oscillogram then showed high-frequency ripples of small amplitude, afterwards becoming definitely negative and remaining negative for about 0.005 sec. The p.d. then became oscillatory and reached the zero value, remaining zero for about 0.001 sec. After further fluctuations the p.d. again became definitely negative and remained negative, but developed occasional ripples of high frequency and small amplitude.

That the curious activity of the p.d. after the current has ceased to flow appears to be definitely due to the iron of the bobbin, is evident from the fact that when a solenoid of similar winding data, but wound on an ebonite bobbin, burst, no such high-frequency ripples were developed in the p.d. It would further appear that the atomic disturbance of the material of the bobbin took some considerable time to settle down to a state of quiescence, that is, in so far as its external effects are concerned. It is hoped to obtain, at a later date, further experimental data relative to these curious phenomena in the p.d. wave.

As previously stated, the prime purpose for which this method of generating very intense magnetic fields was devised was to ascertain the effect of repeated application of such fields on a magnetic substance.

Before subjecting the specimen to the intense magnetic fields the magnetisation (*i.e.*, the *B-H*) curve is determined; the specimen is then inserted in the tubular core of the solenoid and the oscillating switch E, fig. 1, is set in operation so that a condenser discharge passes through the solenoid about once every 5 minutes. After a few hundred discharges have in this way taken place, the specimen is removed and its magnetisation curve is again determined.

It has been found that the magnetisation curve for a specimen of Stalloy is distinctly improved after having been subjected to the intense magnetic fields in this way. This process is being carried out for a long period of time to ascertain what limit, if any, there is to the observed change in the magnetisation curve due to the repeated application of the very intense magnetic fields. Tests will also be made on specimens of bismuth and other representative materials.

A Modern Hydro-electric Project.

Some Particulars of the Scheme of the Southland, New Zealand, Electric Power Board.

A DESCRIPTION of the above scheme, written by Mr. H. P. Thomas, chief engineer to the Southland Electric Power Board, has appeared in the *Southland Daily News*. The generating plant of the undertaking, which was inaugurated during the past year, is situated on the banks of the Waiau River, utilising the flow of the Monowai River with an effective head of 154 ft. The latter river is fed from the Monowai Lake. Its water is regulated and its course has been changed so that by means of a canal and steel pipes it flows over the plateau to the terrace edge and down penstock pipes to the power house, instead of as formerly in a ravine cut through the softer strata. By damming the old outlet from the lake, its level has been raised eight feet, giving an increased draw-off of 56,000 acre-feet. A timber- and clay-core earth-filled dam is placed across the Monowai River at its source. This measures 305 ft. long and contains 13,000 cu. yd. of material. The core consists of two rows of steel-shod piles driven 7 ft. into the papa which forms the bed of the stream. A concrete control dam with four gated sluiceways spans the old waterway. In constructing this dam, solid papa was cut out of the bed and concrete poured on the fresh surface of the excavation. The flow of the water through the sluiceways is regulated by stop-logs sliding in channels at each side of the gateways.

An impounding weir and spillway has been constructed at the canal entrance across the bed of the river. The weir not only diverts the water into the canal but also impounds some 30 acre-ft. of storage, besides giving a spillway twice the width of the old river bed, so that in times of flood the waters can pass down the old channel without damaging the canal or forebay.

The canal is 40 ft. wide at the bottom with slopes of 1 to 1 of stiff clay and 1½ to 1 where the banks are raised by means of clay embankments, each of which has a concrete core wall 2 ft. thick running down the centre line to prevent leakage. A concrete forebay is arranged at the canal end to accommodate two pipes of 8 ft. 7 in. internal diameter; it is fitted with steel lifting gates. The main pipe line is 33 chains long and has been built in 6-ft. sections. Each of the latter has its own cradle support, and three anchor blocks have been built into the line with an expansion joint at the lower side of each. A surge tank, connecting the main pipe to the penstock pipes, is constructed of steel on a concrete base, and is provided with a central discharge tube which empties by means of a concrete lined channel into the ravine of the Monowai. The generator penstock pipes rest on concrete supports and are 63 in. in diameter, 365 ft. long, and anchored in two places.

The power house is of reinforced concrete construction and is 80 ft. long, 59 ft. wide, and 41 ft. 6 in. (floor to gable) high. The main floor is of the "tank" type, permitting the Waiau to rise 4 ft. 6 in. above the floor level without interfering with the operation of the plant. Two 3,200-h.p. main turbines were installed at the time the information was prepared. They are of the double-runner Francis end-entry type, built by Messrs. Boving & Co. They are controlled by oil-pressure governors. The valves are hydraulically operated from the main floor, and the turbines discharge into tail races built beneath the power house and heavily reinforced between piers. The generators, each of 2,000-kW capacity, were supplied by the English Electric Co., and are equipped with temperature indicating coils and Merz-Price protective gear. Two turbine-driven exciters are installed, each capable of exciting all the machines in the station. Although the building will only accommodate three 2,000-kW sets at present, its south end is temporary and so designed that the building can be doubled in length and a further 6,000 kW of plant installed. The system of generation is 3-phase, 6,600 V, and the energy generated is distributed from a main 6,600-V switchboard to an outdoor sub-station at Monowai, where the pressure is stepped up to 66,000 V for transmission. Two transmission lines convey the energy to Gore and Invercargill, running parallel, 100 ft. apart, from Monowai to Winton, where interconnection between the lines is provided. The cable lines are carried by pin-type insulators on Australian hardwood arms framed into ironbark poles; the average span is six chains. Sub-stations at Winton, Invercargill and Gore act as receiving stations and distribute the energy over the whole of Southland at 11,000 V. Automatic air-break switches control the transformers on the higher-pressure side, and truck-type oil circuit breakers inside the sub-stations control the 11,000-V feeders, of which there are 18 radiating from the sub-stations mentioned. At load centres transformers are installed, mounted on poles, reducing the voltage to working pressures of 400 and 230 V, 3-phase.

Railway Electrification in South Africa.

An Introduction to the Study of Electric Traction in Natal.

(*Concluded from page* 280.)

Equipment of Track.

The amount of curved track is 40 per cent. of the total line, and the type of equipment adopted to meet the onerous conditions consists of a single contact wire from which the locomotives collect current, suspended from the catenary wire by means of hangers; the bare copper feeder wires, where necessary, are also carried on these structures.

Extensive track alterations have been carried out by the Administration in marshalling yards and stations to procure general improvement and to provide for increased traffic, which electrification may be expected to bring. The work has had to be carried out without interruption of the ordinary traffic, and was made formidable owing to unusually heavy rains during 1925 and to the growth of traffic, which proved a record during the construction period.

All insulated fittings provide double insulation to earth, and the main catenary and feeder supporting insulators are carried on a horizontal lead-covered steel spindle, on which is threaded the centre insulator and the two end insulators; strain insulators are of the double-reel type connected together by forged steel side straps; all other insulation is of the pin and egg type. Clamps and clips are throughout composed of non-ferrous materials, and special care has been taken to avoid, as far as possible, any contact between steel and copper wires. On double track, the up and down tracks are kept independent of one another.

The steelwork for the whole equipment was manufactured in South Africa, and approximately 70 per cent. of the rolled-steel sections required were actually rolled in South Africa. The standard steelwork consists of some ten different types. The foundation work throughout was very difficult, and much blasting was involved.

The general sectioning principle is that each station may be wholly or partially alive, and the supply to the adjacent sections maintained by feeders through the stations; or, in case of necessity, the whole of the equipment, including track and feeder wires, can be isolated. The type of section switch employed has a main knife contact between two horns for disrupting the arc, mounted on the roof of special switch houses alongside the track, which also house the lightning arresters, &c. Automatic breakers are also being installed at all sub-station feeding points; they are of a special high-speed type and are remote controlled, *i.e.*, they can be closed from the adjacent signal cabins.

The ordinary running rails are bonded to form a return circuit. Cross bonding between tracks and between rails is provided for and, in addition, approximately every fifth structure of the overhead equipment is bonded to the running rails.

Electric Locomotives.

The S.A.R. main-line steam locomotives have long enjoyed an enviable reputation throughout the railway world. Their performances on a 3-ft. 6-in. track under mountain road conditions is without a peer anywhere, and in attempting to go one better with electric locomotives, the consulting engineers essayed a task which only sound knowledge, tempered with long experience in electric traction, could hope to justify. To attempt to do so with direct-geared motors operated by high-potential direct current, partakes of the faith which moves mountains. To be able to claim that where the world's largest 3-ft. 6-in. gauge steam locomotives were taxed to their utmost in handling freight traffic, the "electrics" can now do so with comparative ease, is to say that their faith is justified, for the mountains have been eliminated. There are still some lions in the path, but no opponents of electrification have offered to insure their lives.

The scheduled time for a steam locomotive to haul heaviest trains between Glencoe and Maritzburg is 16¼ hours with the following loads:—

From Glencoe to Ladysmith	...	...	1,000 tons
From Ladysmith to Mooi River	...	...	720 tons
From Mooi River to Maritzburg	...	...	820 tons

The 12th and 14th classes of steam locomotives are used, one per train. The "electrics" do 1,500 tons all the way in 10¼ hours.

The load for the up-journey under steam is 385 tons and with "electrics" 800 tons; three electric units are employed in both instances. The times given are all scheduled times, depot to depot. The estimated capacity of the Glencoe-Maritzburg section as a single steam line proposition is 25,000 tons per 24 hours. With electric working, 35,000 tons is estimated for, but a considerably higher figure will probably be reached.

On account of the severe physical conditions of the Glencoe-Maritzburg section, the rigid wheel bases of the engines were reduced to a minimum by building the locomotives in units, which can be used singly or coupled in twos or threes, with the control so arranged that one driver is able to handle, equally efficaciously either one, two, or three units.* The design of the locomtives provides for fulfilling the following conditions when three units are coupled together:—

(1) Hauling a train of 1,800 short tons up a gradient of 1 in 100 at from 21 to 22 m.p.h., and hauling the same train on tangent level track at not less than 36 m.p.h., the line pressure in both cases averaging 2,700 volts.
(2) Starting a train weighing 1,800 short tons on a rising 1 per cent. gradient and attaining 22 m.p.h. in three minutes, the line pressure during the accelerating period being 2,700 volts.
(3) Holding a train of 1,640 short tons on a falling gradient by regenerative action alone at steady speeds.
(4) Performing the round trip from Ladysmith to Maritzburg and back to Ladysmith once in 24 hours for six days a week.
(5) Hauling a 1,430 short-ton train down from Ladysmith to Pietermaritzburg in 7 hours 7 minutes, of which 52 minutes are spent in stops.
(6) Hauling a 700-ton train from Pietermaritzburg to Ladysmith in 7 hours 27 minutes, of which 101 minutes are spent in stops; the speed through all stations at which the trains do not stop is limited to 15 m.p.h.
(7) All locomotives to be capable of running at a maximum speed of 45 miles per hour.

So well do the "electrics" fulfil these conditions that the Administration has had to take very strict measures to prevent drivers from making up time lost by romping along the mountain track with 1,500 tons behind them.

The body is borne by two pivots carried on the bogies and so suspended that it is relieved of all buffing shocks. Each roof carries two pantographs, isolating switches, and lightning arrester. There are four motors to each unit, and each is connected to a driving axle by single reduction gearing; each motor has a capacity of 300 h.p. and is designed for 1,500 volts. A motor unit consists of two motors connected permanently in series so as to be suitable for the distribution pressure of 3,000 volts; the motors are then grouped by the control apparatus in series and in parallel for regulating the speed of the train.

The motors are four-pole machines, with commutating poles and forced ventilation supplied by auxiliary blowers mounted on extensions of the two motor-generator shafts. The motors can exert sufficient torque to slip the driving wheels under any conditions of rail without injury; all moving parts are automatically lubricated.

A great feature of the scheme is the use on descending gradients of the regenerative action of the motors. This system of braking has been tried right through the zone and its success is assured, but it is being introduced cautiously as the drivers become thoroughly acquainted with the handling of the trains under the new conditions. The advantages which it is hoped to secure are:—(1) A saving of power, which may amount to 15 per cent. (2 Elimination of brake-shoe and wheel wear, and consequent reduction of maintenance charges. (3) General improvement of braking, as compared with air brakes. (4) Reduction of wear of track on grades and curves. (5) Increased safety to passengers through the duplication of the braking system. (6) Increased comfort of passengers by steadier running and the elimination of grinding noises on heavy grades.

The drivers' cabs contain all the control gear, meters, brake valves and electro-pneumatic gear for raising and lowering the pantographs. Two auxiliary compartments between a h.p. chamber and the two cabs house the auxiliary plant, which includes a 3,000-volt, 28-kW m.g. set furnishing 80 volts for exciting the fields of the main motors when regenerating, and a 3,000-volt, 16-kW m.g. set which supplies 110 volts for the control circuits, light, the exhauster, the compressor, the cab heaters, exciting the 28-kW m.g. set, and charging the battery. An air compressor driven by a series 2-pole motor through double helical gearing operates the brakes and controls. The centre portion of the body is occupied by a chamber which houses all the h.p. control gear, including the resistances.

The control is electro-pneumatic, and the wiring is so arranged that in the event of any section of the gear breaking down, the defective part may be isolated without interfering with the operation of the rest of the locomotive, or locomotives. The interlocking arrangements controlling the various switch movements by one driver at a master controller are very ingenious, but too complicated to be examined closely in a condensed review.

The difficulties and defects which have been encountered are, with the exception of the silting of the Tugela River by the power station intake under abnormal flood conditions, generally less than an experienced engineer would expect when starting work of this magnitude. Lightning has proved a blistering irritant on the track circuits, but is gradually being controlled, and by the opening of the next lightning season will have had the sting taken out of it. The success of the scheme as an engineering venture is undoubtedly assured. To what extent its success as a financial venture has been retarded by the original estimates having been exceeded, can only be determined after a few months' running, but there is good reason

*See ELEC. REV., August 15th, 1924, p. 256.

to believe that even though the profits may not be as large as was at first anticipated, they will indeed justify the vast outlay which the scheme has necessitated.

Cape Town Suburban Railways.

To the number of railways which are being changed over from steam to electric traction, may now be added the Cape Town suburban lines. This normal suburban scheme was held over for a time after tenders had been called for, as has been explained at the beginning of the foregoing paper; the work of conversion has, however, been proceeding for some months and embraces the electrification of the section of line extending from Sea Point, to the west of Cape Town, through Cape Town to Simonstown, a distance of about 25 route miles, nearly half of which is along the coast.

In all, approximately 136,000 yards (over 77 miles) of underground power, telephone, and pilot cable will be used, as far as is at present known, consisting of :—

29,410 yards 0.1 sq. in. and 21,100 yards 0.05 sq. in. extra-high-pressure, 3-core, paper-insulated, lead-covered, and single wire armoured cable suitable for a working pressure of 33,000 volts.

13,280 yards 0.2 sq. in., 540 yards 0.25 sq. in., and 7,120 yards 0.1 sq. in. of similar cable, but suitable for a working pressure of 12,000 volts.

540 yards 0.05 sq. in. extra-high-pressure single-core, paper-insulated, lead-covered, phosphor-bronze tape-armoured and compounded cable suitable for a working pressure of 33,000 volts; and 20,160 yards 3-core pilot and 3-pair telephone cable, paper-insulated, lead-covered and single wire armoured.

37,500 yards 8-pair and 4,820 yards 25-pair dry-core telephone cable, single wire armoured, and 1,680 yards 10-pair dry-core telephone cable, steel tape armoured.

All of this cable is being supplied by Messrs. W. T. Henley's Telegraph Works Co., Ltd., who are also jointing and laying, or supervising the laying of, all but a small fraction of the cable.

The scheme calls for two power stations, at Dock Road and at Salt River, and eight sub-stations.

Ceylon's Electrical Imports.

THE following table shows the value of Ceylon's imports of electrical and allied materials during the past year. The figures have been taken from the recently published official returns. The corresponding statistics for 1924 have been added and notes of decrease or increase are also given :—

	1924. Rupees.	1925. Rupees.	Inc. or dec. Rupees.
Control and switchgear—			
Total, all from United Kingdom	3,000	8,000	+ 5,000
Generators, alternators and dynamos—			
Total	100,000	175,000	+ 75,000
From United Kingdom ...	95,500	166,000	+ 70,500
,, Germany	—	2,000	+ 2,000
,, United States	*	3,600	—
Motors—			
Total	41,000	20,000	- 21,000
From United Kingdom ...	37,000	17,000	- 20,000
,, United States	2,500	2,000	- 500
Transformers and converters—			
Total	14,000	500	- 13,500
From United Kingdom ...	—	500	+ 500
,, United States	14,000	—	- 14,000
Magnetos, ignition—			
Total	400	120	- 280
From United Kingdom ...	150	120	- 30
Electric wires and cables (insulated)—			
Total	340,000	272,000	- 68,000
From United Kingdom ...	338,000	262,000	- 76,000
,, Germany	1,000	1,000	—
,, United States	*	2,400	—
,, Holland	*	1,600	—
Telegraph and telephone instruments and apparatus—			
Total	128,000	213,000	+ 85,000
From United Kingdom ...	105,000	181,000	+ 76,000
,, United States	12,000	16,000	+ 4,000
,, Sweden	9,000	8,000	- 1,000
Electric lighting accessories and fittings, including switches—			
Total	416,000	305,000	-111,000
From United Kingdom ...	325,000	209,000	-116,000
,, Germany	24,000	38,000	+ 14,000
,, United States	27,000	29,000	+ 2,000
,, Holland	29,000	18,000	- 11,000
Electrical goods and apparatus not elsewhere specified—			
Total	369,000	581,000	+212,000
From United Kingdom ...	302,000	518,000	+216,000
,, India	13,000	13,000	—
,, France	*	3,000	—
,, United States	29,000	38,000	+ 9,000
,, Germany	14,000	5,000	- 9,000
Electrical machinery not elsewhere specified—			
Total	119,000	139,000	+ 20,000
From United Kingdom ...	84,000	100,000	+ 16,000
,, Germany	10,000	3,000	- 7,000
,, United States	10,000	33,000	+ 23,000
,, Italy	*	3,000	—
Magnetos, road—			
Total	15,000	16,000	+ 1,000
From United Kingdom ...	11,000	11,000	—
,, Germany	4,000	4,000	—

*Not specified.

Electrical Imports of the Irish Free State.

ELECTRICAL goods and apparatus were imported into the Irish Free State last year to the total value of £403,000, of which £346,000 represented British manufactures, while electrical machinery amounted to £115,380, of which £96,800 came from Great Britain. We show below the principal classes of goods and the respective shares of Great Britain and Northern Ireland. The share of Belgium and Germany in the wire and cable trade is also set out. There were imports from Germany of electrical machinery to the value of £11,000, compared with £1,600 in 1924, and of other electrical goods and apparatus to the value of £7,700, or about the same as last year, whilst imports of electrical machinery from Switzerland fell from £13,600 in 1924 to £5 only in 1925.

	1924. £	1925. £	Inc. or dec. £
Electrical goods and apparatus—			
Wires and cables	78,000	124,000	+ 46,000
From Great Britain ...	60,500	91,500	+ 31,000
,, Northern Ireland ...	6,000	1,000	- 5,000
,, Germany	9,500	20,000	+ 10,500
,, Belgium	6,000	9,000	+ 3,000
Telegraph and telephone instruments and apparatus	28,500	29,000	+ 500
From Great Britain ...	28,000	28,000	—
,, Northern Ireland ...	300	—	- 300
*Electric lamps and parts ...	62,000	59,000	- 3,000
From Great Britain ...	58,000	55,000	- 3,000
,, Northern Ireland ...	1,500	1,600	+ 100
*Batteries and accumulators...	33,000	36,000	+ 3,000
From Great Britain ...	29,000	33,000	+ 4,000
,, Northern Ireland ...	1,000	1,000	—
Wireless sets and parts ...	91,000	85,000	- 9,000
From Great Britain ...	89,000	74,000	- 15,000
,, Northern Ireland ...	2,500	9,500	+ 7,000
Other electrical goods and apparatus	99,000	71,000	- 28,000
From Great Britain ...	90,000	64,000	- 26,000
,, Northern Ireland ...	4,500	3,000	- 1,500
Electrical machinery—			
Generators	13,500	18,000	+ 4,500
From Great Britain ...	12,000	13,000	+ 1,000
,, Northern Ireland ...	500	1,000	+ 500
Motors	17,000	23,000	+ 6,000
From Great Britain ...	16,500	22,000	+ 5,500
,, Northern Ireland ...	150	1,000	+ 850
Other descriptions	66,000	74,000	+ 8,000
From Great Britain ...	50,000	62,000	+ 12,000
,, Northern Ireland ...	2,000	1,000	- 1,000

*Other than for motor cars.

Electrical Trade of Kenya and Uganda.

THE following table, based on the recently-issued official trade returns, shows the value of the imports of electrical and allied material into Kenya and the Uganda Protectorate during the past year. The figures for 1924 have been given for purposes of comparison and notes of any increases or decreases added.

	1924. £	1925. £	Inc. or dec. £
Electric wire and cable, insulated—			
Total	2,600	8,600	+ 6,000
From United Kingdom ...	2,500	8,500	+ 6,000
,, Germany	—	100	+ 100
Electric wire and cable, not insulated—			
From United Kingdom ...	6,000	2,200	- 3,800

	1924. £	1925. £	Inc. or dec. £
Electrical goods and apparatus not elsewhere specified—			
Total	29,000	27,000	– 2,000
From United Kingdom ...	28,000	24,000	– 4,000
,, Germany	400	2,000	+ 1,600
,, United States	500	1,000	+ 500
Telegraph and telephone instruments—			
From United Kingdom ...	7,000	13,000	+ 6,000
Cranes, hoists, and lifting machinery—			
Total (United Kingdom) ...	17,400	36,000	+ 18,600
Electrical machinery and parts—			
Total	19,000	31,000	+ 12,000
From United Kingdom ...	17,500	25,000	+ 7,500
,, France	400	—	– 400
,, United States	1,000	2,000	+ 1,000
,, Belgium	—	2,000	+ 2,000
,, Sweden	—	1,000	+ 1,000
Steam engines—			
From United Kingdom ...	26,000	39,000	+ 13,000
,, United States	1,000	300	– 700
,, Germany	—	4,000	+ 4,000
Industrial machinery and parts—			
Total	193,000	236,000	+ 43,000
From United Kingdom ...	175,000	193,000	+ 18,000
,, India	4,000	7,000	+ 3,000
,, Germany	6,600	20,000	+ 14,000
,, United States	4,000	11,000	+ 7,000
Pumps and pumping machinery—			
Total	10,000	9,000	– 1,000
From United Kingdom ...	9,000	7,500	– 1,500
,, United States	700	700	—
Machinery, not specified, other than agricultural—			
Total	19,000	25,000	+ 6,000
From United Kingdom ...	17,000	21,000	+ 4,000
,, Germany	700	2,000	+ 1,300
,, United States	500	1,500	+ 1,000

Selected Radio-Telephone Apparatus.

Recent Developments and Improvements.

The "Smoothac" Rheostat.

During the short while that the rheostat shown in fig. 1 has been on the market it has attracted favourable attention. Besides good workmanship and finish, its design is robust and it requires little panel space and one hole only for fixing. Its

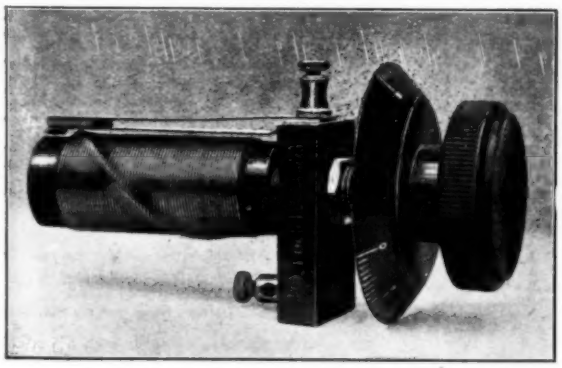


Fig. 1.—The "Smoothac" Rheostat.

smooth action gives it its name, and it will be noted from the illustration that one-turn helical contact with the horizontal spring is obtained by winding a helix on the cylinder underneath the resistance wire. Messrs. A. W. STAPLETON hold the sole manufacturing rights of this device for Great Britain.

"Lewcos" Multiway Leads.

Attention to the wiring of a set assists the neat assembly of a receiver, and in this connection multiway battery leads are useful. A series of such leads is being put upon the market by the LONDON ELECTRIC WIRE CO. & SMITHS, LTD., under the name of "Lewcos." These leads are approximately 5 ft. in length, and consist of two large section v.i.r. conductors to be used for l.p. connections, together with a number of small v.i.r. flexible wires for connection to h.p. terminals and grid-bias battery. The cord is completely braided overall with blue glace cotton, and the ends are provided with Erinoid spade tags and wander plugs of distinctive colours, which give a very pleasing appearance to the finished cord. A feature of the terminals is their adaptability, being such that the spade tags can be removed by merely unscrewing the metal part and a larger spade tag attached if desired; the wander plugs are likewise detachable.

The "Onemeter."

The instrument illustrated in fig. 2 is a recent product of LESLIE DIXON & Co., and should be useful for making electrical measurements. It has been placed on the market primarily for the benefit of radio enthusiasts; of the moving-coil d.c. pattern, the one instrument enables amperes, milliamperes, microamperes, volts, millivolts ohms, and megohms to be accurately measured. It is dead beat, has sapphire bearings, a knife-edge needle, and a double scale, the dial diameter being 2½ in. A front zero adjuster is provided, and the full-scale current is said to be only 2 mA; internal resist-

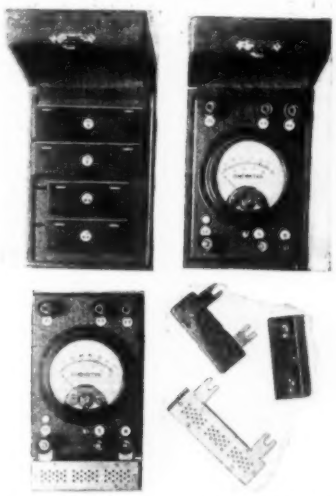


Fig. 2.—The "Onemeter" with Multipliers.

ance, 500 ohms per volt; and sensitivity, 100 millivolts. Current and voltage multipliers to any of 58 ranges are obtainable with specially-shaped clips which avoid confusion and, as fig. 2 shows, the "Onemeter" is contained in a leather-finished case measuring 2 in. by 3¼ in. by 5¼ in., and cases of the same size hold four multipliers. The terminals are ebonite covered and have hollow stem plug sockets. The safety contact key is a valuable feature, and is a guard against damage: a small press button has a double contact spring mounted in the case; gentle pressure brings the first contact into the instrument circuit through a safety resistance which prevents a sudden overload which might damage the meter movement. Assuming the deflection to be small with the light pressure, the safety contact key button may be pressed home making direct contact, and the exact reading taken. If desired, the "Onemeter" on its panel may be fitted to any radio receiving or transmitting set, and plugs fitted for rapid measurement of various circuits.

A New Tuning Unit.

A new tuning device, which is claimed to be capable of development to the point of displacing the usual plug-in coil and materially simplifying tuning operations, has been invented by Mr. J. Paterson, of the County Cycle & Motor Co., Ltd. It is described as occupying little more space than an l.f. transformer and may be readily fixed to existing receiving sets; dispensing with coils in the accepted sense, it is said to cover the broadcast band from 100 metres upwards and with the aid of a simple loading coil the higher wave-lengths also. Aerial- and anode-tuning models are to be made, providing for the alternative use of tuned-anode and resistance-capacity coupling.

The "Ray"-type H.P. Battery.

We have received a 20-volt sample of the "Ray"-type battery of accumulators which the HART ACCUMULATOR CO., LTD., is marketing for use in place of the usual dry high-voltage

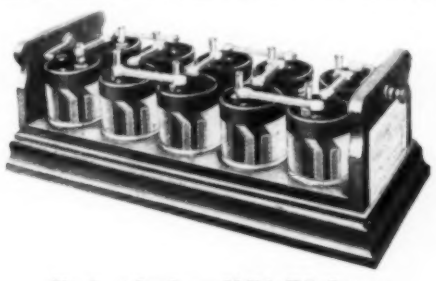


Fig. 3.—"Ray"-type 20-Volt H.P. Battery.

cells in receiving sets. It is a well-made British product, and the individual 2-volt cells are contained in circular glass jars with sealed lids, each group being fitted in a waxed wood crate, as illustrated in fig. 3, the glass jars fitting into recesses in the wooden base so that they are not easily displaced. These batteries are made up into 20- and 30-V groups of 10

and 15 cells, respectively, as standard, and the wood crates are arranged so that they can be placed on top of each other, giving compact assembly in minimum space when upwards of 40 volts is required. The charging rate is from 0.06 to 0.08 ampere, and the minimum discharge rate is 0.4 ampere. The crate shown in fig. 3 is only 11 in. long by 4⅛ in. wide by 3¼ in. high, and it weighs 6 lb. with acid.

The Sarbolt Insulator.

A receiving aerial insulator that should give good results is illustrated in fig. 4. A product of the HATTON SUPPLY CO., it is made of porcelain and screwed on to a galvanised wrought-iron stem, on the shoulder of which is a damp-proof felt washer to keep the thread free from moisture and allow for expansion and contraction. Several holes are provided in the bent metal stem so that the halyard swivel hook can be adjusted as required, the insulator tending to hang naturally

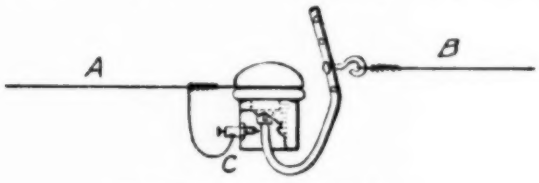


Fig. 4.—The "Sarbolt" Hooded Insulator.

vertical as most of its weight falls below the axis of the aerial. Thus, the under side of the insulator petticoat remains dry in all weathers and maintains good surface insulation. Another feature is the provision of a sparking point between the aerial terminal C and the bracket, so that by using a wire halyard B the aerial A is protected against damage by lightning, the discharge reaching earth through the gap and halyard instead of by way of the lead-in wire and receiving apparatus.

Trade-Mark Applications.

THE following are among the recent applications for British trade marks. Objections against any of the proposed marks may be entered within one month from August 11th:—

Triumph. No. 467,634. All goods in Class 8, but not including electric cables.—A. H. Clackson, Ltd., 119, Fleet Street, E.C.4.

Beam (lettering and design). No. 468,704. Class 8. Electric batteries (not medical) and loud speakers.—Lester & Marquis, 15-16, Thavies Inn, Holborn Circus, E.C.1.

Portadyne. No. 470,392. Class 8. Apparatus for use in radio-telegraphy and telephony.—Whittingham, Smith & Co., 4a, St. Mary's Square, Ealing, W.5.

Hermes (lettering and design). No. 469,502. Class 8. Electric cables.—Richard Johnson, Clapham & Morris, Ltd.

Critic. No. 471,316. Class 8. Instruments and apparatus for use in connection with radio-telegraphy and telephony.—Franklin & Freeman, Ltd., 13, Appold Street, Finsbury, E.C.2.

Titanafram. No. 471,542. Class 8. Loud speakers.—Titanafram Corporation, Jersey City, N.J., U.S.A. (British representatives: Cruikshank and Fairweather, 65-66, Chancery Lane, W.C.2.)

Formapex. No. 468,583 Class 50. Insulating materials for electrical purposes.—Ioco Rubber and Waterproofing Co., Ltd.

Dielectrol. No. 468,764. Class 50. Oils for electrical insulating purposes.—F. J. P. Rose, trading as the British Insulating Oil Varnish Co., 54, King's Road, Wimbledon, S.W.19.

Published Specifications.

Compiled expressly for this journal by Patent Agents
The name of the applicant's patent agent, if any, will be found on the printed specification.
The numbers in parentheses are those under which the specification will be printed and abridged, and all subsequent proceedings will be taken.

1925.

2,004. "Vibratory diaphragms." E. Hueter. January 22nd, 1924. (228,176.)

5,019. "Electrically-driven drilling-machines and like machine tools." W. Asquith (1920), Ltd., J. W. S. Asquith, and G. Feather. February 24th, 1925. (255,502.)

5,022. "Electrically-driven radial drills." W. Asquith (1920), Ltd., J. W. S. Asquith, and G. Feather. February 24th, 1925. (255,505.)

3,775. "Means and method of wiring-up and executing electrical circuits embodied in wireless sets and the like." A. Edwards. April 15th, 1925. (255,512.)

10,215. "Variable electric condensers." E. A. Willson. April 20th, 1925. (255,517.)

10,393. "Horns or trumpets for sound-reproducing apparatus." Automatic Telephone Manufacturing Co., Ltd., and S. R. Smith. April 21st, 1925. (255,520.)

10,447. "Crystal detectors for wireless receivers." I. B. Blaiberg. April 22nd, 1925. (255,524.)

10,450. "Electrically-operated indicating devices." D. W. Carlisle. April 22nd, 1925. (Addition to 232,340.) (255,525.)

10,484. "Multi-layer air-space inductance coil." Igranic Electric Co., Ltd., and A. H. Curtis. April 22nd, 1925. (255,526.)

10,516. "Incandescent electric lamps and heat-radiators." A. F. Berry. April 22nd, 1925. (255,528.)

10,591. "Illuminated signs." H. J. Pearce. April 23rd, 1925. (255,531.)

10,601. "Telephone systems." Automatic Telephone Manufacturing Co., Ltd. August 22nd, 1924. (Addition to 7,256/25.) (238,851.)

10,657. "Electric arc lamps." J. R. Quain. April 24th, 1925. (255,534.)

10,742. "Thermionic valves." F. Warner. April 24th, 1925. (255,543.)

10,752. "Variable tuning and loading devices, suitable for use in wireless telegraphy and telephony." N. H. Clough. April 24th, 1925. (255,547.)

11,098. "Electric tumbler switches." General Electric Co., Ltd., and A. E. Ide. April 29th, 1925. (255,559.)

11,372. "Draw-out electric switchgear." M. J. Railing and C. C. Garrard. May 1st, 1925. (Cognate application 32,033/25.) (255,565.)

11,719. "Electric socket or coupling elements, and the manufacture thereof." J. A. Crabtree. May 6th, 1925. (255,572.)

12,669. "Gas or electric pendants, or the like." J. I. Kirby. May 15th, 1925. (255,580.)

12,751. "Electric telegraphy." W. G. R. Jacob and Eastern Telegraph Co., Ltd. May 15th, 1925. (255,581.)

12,947. "Vibratory diaphragms for acoustical instruments." British Thomson-Houston Co., Ltd., J. H. Butcher, and E. G. Crossling. May 18th, 1925. (255,582.)

13,345. "Electrical condensers." W. J. Cole and Telegraph Condenser Co., Ltd. May 21st, 1925. (Addition to 14,570/25.) (255,585.)

13,609. "Crystal detectors for radio apparatus." A. L. Landau. May 25th, 1925. (Cognate application 26,802/25.) (255,587.)

14,660. "Automatic switch mechanism for the control of wireless receiving sets and like purposes." A. W. Gamage, Ltd., and J. S. Parker. June 5th, 1925. (255,602.)

14,966. "Starting arrangements for electric motor converters." General Electric Co., Ltd., and M. L. Kahn. June 9th, 1925. (255,603.)

15,427. "Electric converters." P. M. R. Sallis. June 14th, 1924. (235,601.)

17,037. "Gaseous electric conduction devices." British Thomson-Houston Co., Ltd. July 17th, 1924. (237,235.)

17,038. "Electric discharge devices." British Thomson-Houston Co., Ltd. July 17th, 1924. (237,236.)

17,128. "Short-wave transmission systems." Standard Telephones & Cables, Ltd. (formerly Western Electric Co., Ltd.) (Western Electric Co., Inc.). July 3rd, 1925. (Patent of addition not granted.) (255,622.)

17,210. "Mounting inductance coils." R. G. E. Spawforth. July 4th, 1925. (255,625.)

17,385. "Thermionic valves." Radions, Ltd., and A. W. Coates. July 7th, 1925. (255,628.)

17,563. "Electrical water-heaters." A. K. Croad (Naamlooze Vennootschap Fabriek van Instrumenten en Elektrische Apparaten Inventum). July 8th, 1925. (Cognate application 4,012/26.) (255,631.)

18,034. "Transformers for electric arc-welding apparatus." F. C. Owen. July 14th, 1925. (255,635.)

18,098. "Pictures and the like and means for reproducing and/or telegraphing them." Marconi's Wireless Telegraph Co., Ltd. July 16th, 1924. (237,263.)

19,303. "Battery boxes of electric locomotives." A. W. Booth and C. D. Cuppleditch. July 30th, 1925. (255,644.)

19,617. "Fine adjustment devices for tuning radio-receiving apparatus and the like." J. P. Burke. August 1st, 1924. (237,926.)

20,452. "Step-by-step switching apparatus for telephone systems." Coventry Automatic Telephones, Ltd., and C. C. Pluckette. August 14th, 1925. (255,657.)

20,834. "Methods of and apparatus for measuring the inductance of cables and conductors." Standard Telephones & Cables, Ltd. (formerly Western Electric Co., Ltd.) and W. E. Mougey. August 19th, 1925. (255,660.)

22,637. "Three-phase electric cables." Pirelli-General Cable Works, Ltd., and R. E. Horley. September 10th, 1925. (255,673.)

25,458. "Transformer for constant secondary voltage with varying network voltage." G. Sokolow-Wishnevsky. October 12th, 1925. (255,688.)

26,105. "Electroplating-baths for simultaneously obtaining metallic deposits of various thicknesses." Württembergische Metallwarenfabrik and A. Wolf. October 19th, 1925. (255,691.)

26,681. "Electromagnetic cut-outs." W. Gross. November 7th, 1924. (242,619.)

27,002. "Electric furnaces for bright annealing." Siemens-Schuckertwerke Ges. November 1st, 1924. (242,283.)

27,079. "Locking and quick-releasing devices suitable for accumulator casings and covers and for other purposes." "Cwag" Miners' Supply Co., Ltd., and R. J. Plummer. October 28th, 1925. (255,694.)

27,590. "Electrical resistances." A. Dukinfield-Jones. November 3rd, 1925. (255,695.)

27,740. "Methods of and apparatus for impregnating insulating-tubing or similar objects." International General Electric Co., Inc. November 4th, 1924. (242,648.)

27,943. "Insulators." M. F. H. Gouverneur and F. J. Stevens. November 6th, 1924. (242,656.)

30,608. "Holders for thermionic valves." Aktiebolaget Baltic. December 4th, 1924. (244,106.)

30,705. "Electric heating devices." Igranic Electric Co., Ltd. (Cutler-Hammer Manufacturing Co.). December 4th, 1925. (255,710.)

32,435. "Method of assembling the elements of electric cells." Compagnie Française pour l'Exploitation des Procédés Thomson-Houston. December 24th, 1924. (245,144.)

32,765. "One-way conductor for rectifying alternating current." H. G. Andre. December 26th, 1924. (Addition to 224,871.) (245,166.)

1926.

131. "Method and means for fixing and bonding metallic-sheathed electric wires and cables." H. H. Leage. January 2nd, 1926. (255,722.)

523. "Radiating antenna systems." British Thomson-Houston Co., Ltd. January 30th, 1925. (246,816.)

807. "Bearings for small electrical generators for cycles, motor-cycles, and the like." X. Bullinger. January 10th, 1925. (245,802.)

1,006. "Electric discharge devices." British Thomson-Houston Co., Ltd. April 16th, 1925. (250,906.)

2,159. "Electroplating-baths for simultaneously obtaining metallic deposits of various thicknesses." Württembergische Metallwarenfabrik, A. Wolf, and E. Bauer. January 25th, 1926. (255,736.)

4,700. "Apparatus for converting alternating electric current into direct current." Metropolitan-Vickers Electrical Co., Ltd. February 18th, 1925. (247,971.)

5,289. "Electrical measuring apparatus." Westinghouse Brake & Saxby Signal Co., Ltd. June 18th, 1925. (253,864.)

5,495. "Electric switches." International General Electric Co., Inc. February 26th, 1925. (248,386.)

6,463. "Electric discharge tubes." Naamlooze Vennootschap Philips' Gloeilampenfabrieken. April 18th, 1925. (250,912.)

10,788. "Means for securing the heels of tramway points." P. Pelletier. May 20th, 1925. (252,340.)

10,789. "Spring mechanism for tramway points." P. Pelletier. May 20th, 1925. (252,341.)

11,734. "Filaments for electric incandescent lamps or other purposes." General Electric Co., Ltd. November 26th, 1925. (255,790.)

13,082. "Electric switches." Akt. Ges. Brown, Boveri et Cie. September 4th, 1925. (Addition to 206,522.) (255,795.)

London Traffic Inquiry.—It is reported that the London and Home Counties Traffic Advisory Committee will hold an inquiry in October into the traffic facilities of South-East London. Inquiries have already been held in connection with North-East and East London, but no report has yet been submitted by the Committee, and the question will probably be dealt with fully on completion of the forthcoming inquiry.